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DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
WM. J. HARRIS, DIRECTOR

CENTRAL ELECTRIC LIGHT AND POWER STATIONS

AND

STREET AND ELECTRIC RAILWAYS

WITH SUMMARY OF THE ELECTRICAL INDUSTRIES

1912

WASHINGTON
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CONTENTS.

Page.
SUMMARY OF THE ELECTRICAL INDUSTRIES 11, 12

CENTRAL ELECTRIC LIGHT AND POWER STATIONS.

PART I.—STATISTICAL.

CHAPTER I.—INTRODUCTION AND GENERAL EXPLANATIONS.

Class of stations included 15
Number of central electric stations 15
Centralization 15
Commercial and municipal stations 15
Purely electric and composite stations 15
Free service included as income 16
Comparison with prior censuses 16

CHAPTER II.—DEVELOPMENT OF THE INDUSTRY.

Summary for 1912 17
Isolated electric stations 17
Central station work of electric railways 18
Comparison of central electric stations and gas plants 18
Central electric stations and population 19
Commercial and municipal stations combined 20
Commercial central electric stations 20
Ownership of commercial central electric stations 21
Municipal central electric stations 21
Municipal stations, by population groups of cities 23
Purely electric and composite stations 25

CHAPTER III.—PRIMARY POWER EQUIPMENT.

Kind of power included 28
Number of different kinds of prime movers 31
Steam power 32
The steam engine 33
The steam turbine 34
Water power 34
Hydroelectric stations 35
Gas and oil engines 42

CHAPTER IV.—GENERATING EQUIPMENT AND OUTPUT OF STATIONS.

Dynamos 43
Number of stations without generators 48
Output of stations in kilowatt hours 49
Purchased current 52
Central stations and electric railways combined 53

CHAPTER V.—LINE EQUIPMENT.

Central stations and electric railways 56
Street lamps 58
Stationary motor service 60
Subsidiary equipment 61

CHAPTER VI.—FINANCIAL STATISTICS.

Capitalization 63
Gross and net capital, commercial stations 63
Capital stock and funded debt of commercial stations 63
Cost of construction and equipment 64
Income 66
Expenses 69
Balance sheet, commercial companies 70
Assets 70
Liabilities 71
Balance sheet, municipal stations 71

DETAILED COMPARATIVE SUMMARY 71

309517

CHAPTER VII.—EMPLOYEES, SALARIES AND WAGES.

Page.
Character of the statistics 76

TITLES OF GENERAL TABLES 81
  General tables 82–109

PART II.—TECHNICAL.

TECHNICAL ASPECTS OF THE PERIOD.

General conditions 111–114
Steam power 114–120
Gas and oil plants 120–122
Water power 122–133
Transmission systems 133–137
  Transmissions system of the world operating at and above 70,000 volts, ranked according to operating voltage ....(facing).. 132
Storage batteries 137
Arc lamps 137–141
Incandescent lamps 141–146
Vapor lamps 146, 147
Use of current for power 147–152
Central station steam and hot-water heating and supply of steam for power 152–154
Electricity in agriculture 154–157
Electric vehicles 157–159
Electric heating and cooking 159, 160
Miscellaneous uses and services 160, 161
Regulation and rates 161–176
  Rate schedules 170–176

INDEX 435

MAPS AND DIAGRAMS.

MAPS.

Map 1.—Geographic divisions as defined by the Bureau of the Census 27
Map 2.—Location of hydroelectric central stations reporting water power of 1,000 horsepower or more, by geographic divisions: 1912.. 37

DIAGRAMS.

Diagram 1.—Central electric stations and electric railways—Primary power, by character of power: 1912 29
Diagram 2.—Central electric stations and electric railways—Primary power, by character of power: 1912, 1907, and 1902 29
Diagram 3.—Central electric stations and electric railways—Primary power, by states: 1912 29
Diagram 4.—Central electric stations—Primary power, by states: 1912 and 1902 30
Diagram 5.—Central electric stations—Primary power—Steam, water, and gas—By states ranked according to steam power: 1912 and 1902 30
Diagram 6.—Central electric stations—Steam power, by states: 1912, 1907, and 1902 33
Diagram 7.—Central electric stations—Water power, by states: 1912, 1907, and 1902 34
Diagram 8.—Central electric stations—Gas and oil engines, horsepower, by states: 1912, 1907, and 1902 42
Diagram 9.—Central electric stations and electric railways—Kilowatt capacity of dynamos: 1912 44
Diagram 10.—Central electric stations—Kilowatt capacity of dynamos, by states: 1912, 1907, and 1902 47
Diagram 11.—Central electric stations and electric railways—Kilowatt-hour output: 1912, 1907, and 1902 49
Diagram 12.—Central electric stations—Kilowatt-hour output, by geographic divisions: 1912, 1907, and 1902 51
Diagram 13.—Central electric stations—Kilowatt-hour output, by states: 1912, 1907, and 1902 51
Diagram 14.—Central electric stations—Purchased current, kilowatt hours, by states: 1912 52
Diagram 15.—Central electric stations—Gross income, by states: 1912, 1907, and 1902 68
Diagram 16.—Central electric stations—Income from electric service, by states: 1912, 1907, and 1902 68

ILLUSTRATIONS.

Facing page.
Cleveland Railways Co., Cleveland, Ohio:
  60-cycle rotary converters 112
Long Island Railways, Long Island City, N. Y.:
  Steam turbo-generators 112
United Electric Light & Power Co., New York City:
  New generating station 114
  Generating room 115
  Reactances 115
Pennsylvania Water & Power Co., McCalls Ferry, Pa.:
  Power house, Susquehanna River 122
  Generating station, first five main generators 122

Mississippi River Power Co., Keokuk, Iowa: Facing page.
  Power house 123
  Generating station 124
  Control switchboard 124
  Cross section of 10,000-horsepower vertical shaft single runner turbine 125
  Nine thousand kilowatt-ampere transformer (110,000 Y 11,000) 125
  St. Louis Substation, Electric Company of Missouri 126
    High-tension switching equipment 127
  St. Louis transmission—
    135-foot river-crossing towers 134
    Dead end towers 134
    Standard towers 134
Five-light cluster lamp pillars, Elks Club, New York City 142
Two alba flaming lamps, 45 feet above sidewalk, Plaza, Fifty-ninth Street, New York City 142
Lamp pillars on board walk, Atlantic City, N. J. 142
Electric cooking:
  Hotel range 158
  House range 158
  Three-heat flat, unit stove 158
  Radiant toaster, 550 watts 158

STREET AND ELECTRIC RAILWAYS.

PART I.—STATISTICAL.

CHAPTER I.—INTRODUCTION AND GENERAL EXPLANATIONS.

Page.
Classes of railways included 179
Electrically operated divisions of steam roads 179
Municipal railways 179
Railway and nonrailway operations 180
Period covered 180
Class of companies 180
Operating companies 180
Lessor companies 180
Holding companies 180
Basis of classification 180
Classification according to income from railway operations 180
Classification according to commercial lighting relations 181
Classification as "Elevated and subway" and "Surface" 181
Urban and interurban 181

CHAPTER II.—DEVELOPMENT OF THE INDUSTRY.

Electric railways and central-electric stations 182
Comparison with prior censuses 183
Increase in size of companies 187
Increase in trackage and motive power 188
Traffic 189
Car mileage 190
Car-hours 190
Capitalization 190
Income and expenses 191
Employees 192

CHAPTER III.—POWER, EQUIPMENT AND OUTPUT OF STATIONS.

Power equipment 195-198
Output of stations 198, 199

CHAPTER IV.—TRACK AND ROLLING STOCK.

Track 200-209
  Track operated by electric power 200
  Overhead trolley 201
  Third rail 201
  Conduit 201
  Storage batteries 201
  Gas-electric motors 202

Track—Continued. Page.
Interstate trackage 203
Electrified trackage of all companies and systems 204
Power other than electricity 205
Elevated and subway trackage 205
Ownership of track 206
Leased track 207
Trackage rights 207
Track on private rights of way 208
City and suburban and interurban lines 208
Rolling stock 209–212
Prepayment cars 209
Motor cars 209
Brake equipment 210
Electric locomotives 210
Track and rolling stock of companies classified according to income from railway operations 210
Track and rolling stock of companies classified as "Elevated and subway" and "Surface" 211

Chapter V.—TRAFFIC.

Passengers, car mileage, and car-hours 213
Number of passengers 213
Car mileage 214
Revenue passengers per mile of track 214
Revenue passengers per car-mile 215
Revenue passengers per passenger-car hour 215
Traffic of maximum density 215
Passenger traffic of street and electric railways and steam railroads 215
Traffic of companies classified according to income from railway operations 216
Traffic of companies classified as "Elevated and subway" and "Surface" 216
Car-hours 216
Rates of fare 217–221
Freight, mail, and express business 222

Chapter VI.—CAPITALIZATION.

Basis of statistics 223
Ownership 223
Capitalization 223
Capitalization and cost of construction 225
Holding companies 226
Analysis of dividends and interest 228
Capitalization per mile of road of street and electric railways and steam roads 228
Capitalization of companies classified according to income from railway operations 229
Capitalization of companies classified as "Elevated and subway" and "Surface" 230
Capitalization, by states 230

Chapter VII.—FINANCIAL OPERATIONS.

Introduction 231, 232
Form of accounting 231
Totals for states 231
Income account 232–240
Gross income 232
Condensed income account of operating companies 233
Condensed income account of nonoperating lessor companies 235
Condensed income account of operating and lessor companies combined 236
Condensed income account of operating companies, classified according to income from railway operations 237
Condensed income account of operating companies without and with commercial lighting 238
Condensed income account of companies classified as "Elevated and subway" and "Surface" 239
Operating revenues and miscellaneous income 240–245
Operating revenues 240
Operating revenues of companies classified according to income from railway operations 242
Operating revenues of companies without and with commercial lighting 243
Operating revenues of companies classified as "Elevated and subway" and "Surface" 244
Miscellaneous income 245
Operating expenses 245–250
Operating expenses of companies classified according to income from railway operations 249
Operating expenses of companies without and with commercial lighting 249
Operating expenses of companies classified as "Elevated and subway" and "Surface" 250

Page.
Deductions from income — 250–256
  Taxes — 250
  Interest — 255
  Rent of leased lines and terminals — 255
  Charges for sinking fund and miscellaneous deductions — 255
  Deductions from income for groups of companies — 255
General results of operation — 256–264
  Earnings per mile of track — 258
  Income from railway operations in state — 258
  Earnings per car-mile — 260
  Earnings per passenger — 260
  Operating ratio — 261
  Relation of operating ratio to density of traffic — 263
Balance sheets — 264–268
  Assets — 264
  Liabilities — 265
  Balance sheet of operating and lessor companies — 265
  Balance sheet, by states — 267

CHAPTER VIII.—EMPLOYEES, SALARIES, AND WAGES.

Character of the statistics — 269
Employee and wage statistics of operating companies, by classified groups — 271
Relation of salaries and wages to operating expenses and operating revenues — 273

CHAPTER IX.—SALE OF CURRENT BY ELECTRIC-RAILWAY COMPANIES.

Table 148.—Revenue from sale of current and income of electric light and power departments, by class of service — 275
Table 149.—Electric railways with electric light and power departments — 276
Table 150.—Revenue from sale of current and income of electric light and power departments, by geographic divisions, 1912 — 276

TITLES OF GENERAL TABLES — 277
  General tables — 278–325

PART II.—TECHNICAL ADVANCES IN THE INDUSTRY.

General figures — 327
Power-plant engineering — 327–337
Hydroelectric development — 337–343
Dynamo capacity and purchased power — 343–349
Line construction — 349–356
Advances and changes in street cars — 356–380
  Advances in self-propelled cars — 371–375
  Center-entrance cars — 375–380
New types of electric suburban lines — 380–384
Track construction — 384–391
Street-car illumination — 391–393
Signaling and dispatching — 393–397
Air-brake equipment — 397–401
Electrification of main lines — 401–407
Electric locomotives — 407–411
General features of railway-motor improvement — 411–414
Passenger traffic and fares — 414–420

INDEX — 437

MAPS AND DIAGRAMS.

MAPS.

Maps showing average number of revenue passengers per inhabitant, by geographic divisions: 1912, 1907, 1902, and 1890 — 194

DIAGRAMS.

Diagram 1.—Miles of track, by states: 1912, 1907, and 1902 — 192
Diagram 2.—Number of revenue passengers, by states: 1912, 1907, and 1902 — 193
Diagram 3.—Capitalization outstanding of operating and lessor companies combined, by states: 1912, 1907, and 1902 — 193

*

ILLUSTRATIONS.

Facing page.
Center-entrance, stepless car, New York Railways Co. 356
Low-floor car, Pittsburg Railways Co. 356
All-steel, subway car with three side entrances, Boston, Mass. 357
Center-entrance, end-exit, small-wheel car, Pittsburg Railways Co. 357
Center-entrance double-decked car:
  New York Railways Co. 358
  Pittsburg Railways Co. 358
Standard end-platform car for city service, Chicago, Ill. 359
Single-truck pay-within car for service in small towns, Meridian, Miss. 359
All-steel, center-entrance, interurban car, Kansas City, Mo. 368
All-steel, interurban car, Portland, Oreg. 368
Low end-entrance car for city service, Brooklyn, N. Y. 369
Typical center-entrance trail car, Cleveland, Ohio. 369
Catenary line construction, Kansas City, Clay County & St. Joseph Railway Co. 380
Portable substation, Washington, D. C., & Old Dominion Railway. 380
Line construction, Hoosac Tunnel electrification, Boston & Maine R. R. 402
New York Central lines:
  Electric locomotives. 408
  600-volt locomotives. 408
800–1,200-volt D. C. locomotive, Southern Pacific Railroad Co. 409
2,400-volt locomotive, Butte, Anaconda & Pacific Railway Co. 409

APPENDICES.

Appendix A.—Schedules: Census of electric light and power stations and street and electric railways: 1912. 423–428
  Census of electric light and power stations. 423
  Census of street and electric railways. 425
    Operating companies. 425
    Nonoperating and lessor companies. 428
Appendix B.—Instructions to special agents. 429–434

LETTER OF TRANSMITTAL.

DEPARTMENT OF COMMERCE,
Bureau of the Census,
Washington, D. C., October 15, 1914.

Sir:

I have the honor to transmit herewith the report on the census of central electric light and power stations, and street and electric railways for 1912.

This is the second report on these industries that has been prepared in conformity with the requirements of the act of Congress of June 7, 1906. The canvass for the collection of these statistics was started early in April, 1913. It generally requires about a year to collect satisfactory reports from all establishments covered by a census of this character. The field work for this census, however, was completed by the middle of October, 1913. The results for each state were published as rapidly as the tabulations were finished, the first totals being made public in December, 1913. The United States totals were published in January and February, 1914. A preliminary bulletin was published during June, 1914, which presented the principal data in regard to each branch of the census in each state. The results were made public at an earlier date than they were published for preceding censuses. It was not thought essential, therefore, to hasten the publication of the final report transmitted herewith, and only a limited force was employed in its preparation.

The American Electric Railway Accountants' Association and the National Electric Light Association cooperated with the Bureau of the Census in devising the forms of the schedules used in the collection of these statistics. At prior censuses the office experienced considerable difficulty in securing complete reports from a number of companies. No difficulties of this character were encountered during the census of 1912, and I feel that this willingness on the part of the companies to furnish the information was due largely to securing their cooperation through their associations. Both the American Electric Railway Accountants' Association and the National Electric Light Association appointed committees to confer with the officials of the bureau, and meetings were held in the city of New York, where the form of schedule and method of presenting the statistics were discussed.

The statistics were collected and the report prepared under the supervision of Mr. William M. Steuart, chief statistician for manufactures. As at preceding censuses Mr. T. Commerford Martin, of New York City, was the consulting expert of the bureau and prepared that portion of the report dealing with the technical features of the central station and electric railways industries.

Acknowledgment should also be made of the services of Mr. Frank L. Sanford and Mr. Story B. Ladd, who assisted in the preparation of the text and analytical tables.

Respectfully,

Wm. J. Harris
Director of the Census.

To Hon. William C. Redfield,
Secretary of Commerce.

SUMMARY OF THE ELECTRICAL INDUSTRIES.

GENERAL STATISTICS OF THE INDUSTRIES.

The group of electrical industries covered by the census of 1912 comprises five distinct industries designated as follows: (1) "Central electric light and power stations;" (2) "Street and electric railways;" (3) "Telephones;" (4) "Telegraphs;" and (5) "Municipal electric fire-alarm and police-patrol signaling systems." The industries resolve themselves into two groups of an allied character, light and power stations and railways constituting one group, and telephones, telegraphs, and fire-alarm and police-patrol signaling systems the other. The statistics for the first two industries are presented in this report, while the data for the last three are assembled in a separate report.

The following table is a summary of the leading statistics for the first four industries, separate and combined, for 1912, 1907, and 1902. It shows, for the several items and for each year, the per cent each industry forms of the total, and also gives percentages of increase in capitalization, income, expenses, and net income for the decade 1902–1912 and for each of the five-year periods within the decade.

Municipal electric fire-alarm and police-patrol signaling systems are not operated commercially, and the statistics relating thereto have little in common with the other four industries. They have therefore not been included in this combined summary.

THE ELECTRICAL INDUSTRIES:[1] 1912, 1907, AND 1902.

	Census.	Total.	Central electric light and power stations.	Street and electric railways.	Telephones.	Telegraphs (land and ocean).	PER CENT OF TOTAL.			
							Central electric light and power stations.	Street and electric railways.	Telephones.	Telegraphs.
Number of companies, stations, or systems	1912	8,424	5,221	1,260	[2]1,916	[3]27	62.0	15.0	22.7	0.3
	1907	7,612	4,714	1,236	[2]1,636	[3]26	61.9	16.2	21.5	0.3
	1902	7,789	3,620	987	[4]3,157	25	46.5	12.7	40.5	0.3
Employees, salaries and wages:										
Average number	1912	582,452	79,335	282,461	183,361	37,295	13.6	48.5	31.5	6.4
	1907	428,765	47,632	221,429	131,670	28,034	11.1	51.6	30.7	6.5
	1902	277,474	30,326	140,769	78,752	27,627	10.9	50.7	28.4	10.0
Salaries and wages	1912	$383,058,415	$61,161,941	$200,890,939	$96,040,541	$24,964,994	16.0	52.4	25.1	6.5
	1907	269,229,021	35,420,324	150,991,099	65,009,349	17,808,249	13.2	56.1	24.1	6.6
	1902	160,152,151	20,646,692	88,210,165	36,255,621	15,039,673	12.9	55.1	22.6	9.4
Capitalization	1912	$8,101,927,332	[5]$2,175,678,266	$4,708,568,141	$991,294,115	$226,386,810	26.9	58.1	12.2	2.8
	1907	5,850,101,507	[5]1,096,913,622	[6]3,774,772,096	758,122,214	220,293,575	18.7	64.5	13.0	3.8
	1902	3,324,000,034	[5]504,740,352	[6]2,308,282,099	348,031,058	162,946,525	15.2	69.4	10.5	4.9
Per cent of increase	1902–1912	143.7	331.0	104.0	184.8	38.9	....	....	....	....
	1907–1912	38.5	98.3	24.7	30.8	2.8	....	....	....	....
	1902–1907	76.0	117.3	63.5	117.8	35.2	....	....	....	....
Income	1912	$1,201,168,106	[7]$302,115,599	$579,208,430	$255,081,234	$64,762,843	25.2	48.2	21.2	5.4
	1907	830,827,566	[7]175,642,338	[6]426,900,952	176,700,408	51,583,868	21.1	51.4	21.3	6.2
	1902	463,982,821	[7]85,700,605	[6]250,526,642	86,825,536	40,930,038	18.5	54.0	18.7	8.8
Per cent of increase	1902–1912	158.9	252.5	131.2	193.8	58.2	....	....	....	....
	1907–1912	44.6	72.0	35.7	44.4	25.5	....	....	....	....
	1902–1907	79.0	104.9	70.4	103.5	26.0	....	....	....	....
Expenses—Total, including salaries and wages, interest, taxes, and fixed charges.	1912	$994,336,021	$234,419,478	$497,782,682	$203,754,909	$58,378,952	23.6	50.1	20.5	5.9
	1907	669,665,102	134,196,911	358,113,401	135,475,177	41,879,613	20.0	53.5	20.2	6.3
	1902	366,764,240	68,081,375	202,570,060	65,164,771	30,948,034	18.6	55.2	17.8	8.4
Per cent of increase	1902–1912	171.1	244.3	145.7	212.6	88.6	....	....	....	....
	1907–1912	48.5	74.7	39.0	50.4	39.4	....	....	....	....
	1902–1907	82.6	97.1	76.8	107.9	35.3	....	....	....	....
Net income	1912	$206,832,085	$67,696,121	$81,425,748	$51,326,325	$6,383,891	32.7	39.4	24.8	3.1
	1907	161,162,464	41,445,427	68,787,551	41,225,231	9,704,255	25.7	42.7	25.6	6.0
	1902	97,218,581	17,619,230	47,956,582	21,660,765	9,982,004	18.1	49.3	22.3	10.3
Per cent of increase[8]	1902–1912	123.0	260.8	69.8	137.0	−36.0	....	....	....	....
	1907–1912	28.3	63.3	18.5	24.5	−34.2	....	....	....	....
	1902–1907	65.8	135.2	43.4	90.3	− 2.8	....	....	....	....

[1] Not including municipal electric fire-alarm and police-patrol signaling systems.
[2] Exclusive of systems reporting an annual income of less than $5,000.
[3] Includes the Commercial Cable Company of Cuba in 1912 and 1907 (not reported in 1902).
[4] Includes all systems operated primarily for revenue.
[5] Cost of construction and equipment.
[6] Six companies in 1907 and 30 companies in 1902 failed to furnish this information.
[7] In addition, $36,300,030 in 1912, $20,093,302 in 1907, and $7,703,574 in 1902, was reported by street and electric railway companies as income from sale of electric current for light and power or from sale of current to other public-service corporations.
[8] A minus sign (−) denotes decrease.

The central electric light and power industry includes commercial and municipal central electric stations, but does not include a number of electric light and power stations operated in conjunction with electric railways, the statistics for which are included in the railway reports. The cost of construction and equipment is given in this table, in lieu of capitalization, on account of the inclusion of the municipal stations.

The street and electric railway industry covers both operating and nonoperating or lessor companies, but the nonoperating lessor companies did not report number and salaries of employees, so that the statistics pertaining to employees, salaries, and wages relate to operating companies only. The employees of the lessor companies are of the salaried class and comparatively few in number. All organization and maintenance expenses of the lessor companies are included under expenses. Cognizance has been taken of the rentals passing to the lessor companies from the operating companies for leased roads, and the duplication arising therefrom through the combination of income and expense accounts of both classes of companies has been eliminated.

The telephone statistics for 1912 and 1907 are confined to companies or systems having an annual income of $5,000, whereas the statistics for 1902 cover all systems operated for revenue and include a large number of small organizations and rural lines. These minor systems, though numerous and affecting the statistics for employees, salaries, and wages, represent a comparatively small part of the capitalization, income, and expenses for the telephone industry in 1902.

The proportions that light and power stations and railways, together, on the one hand, and telephones and telegraphs, on the other, form of the total capitalization, income, and expense are quite constant. The first group represented 85 per cent of the total capitalization in 1912, 73.4 per cent of the total income, and 74.7 per cent of the total expenses, as compared with 84.6 per cent, 72.5 per cent, and 75.5 per cent, respectively, in 1902. The percentages for the other group are, of course, the complements of these. In a general way the proportionate loss in one industry of a group has been counterbalanced by a gain in the other industry. Thus the proportion of the total capitalization represented by railways, which was 69.4 per cent in 1902, decreased to 58.1 per cent in 1912, but the proportion for light and power stations increased from 15.2 per cent to 26.9 per cent. Likewise the telegraph systems show a decrease in the proportion their capitalization forms of the total capitalization, namely—from 4.9 per cent in 1902 to 2.8 per cent in 1912—and telephones an increase from 10.5 per cent to 12.2 per cent. The same holds for income and expenses. The returns for electric railways show a marked diminution in the number of companies which generate their power. The generation of current for light and power is becoming more and more a distinct industry, and the growth of the telephone has been in part at the expense of the telegraph.

CENTRAL ELECTRIC LIGHT AND POWER STATIONS

Part I.—STATISTICAL
Part II.—TECHNICAL

CENTRAL ELECTRIC LIGHT AND POWER STATIONS.

PART I.—STATISTICAL.

CHAPTER I.

INTRODUCTION AND GENERAL EXPLANATIONS.

Class of stations included.—The statistics for central electric stations represent all stations which furnish electrical energy for light, power, and heat; for manufacturing, mining, and other commercial enterprises; for private dwellings; and for public uses, such as lighting streets, parks, etc. The statistics for electric stations operated by electric railways are included whenever it was practicable to secure a separate report for the central station work. No reports were required for electric stations operated by mining companies, factories, hotels, etc., which consume all current generated, nor for those operated by the Federal Government and state institutions. Neither were reports required for stations that were idle or in course of construction. The canvass did not cover Alaska, Hawaii, the Philippines, or Porto Rico, therefore the statistics are confined to continental United States.

Number of central electric stations.—The number of central electric stations reported, 5,221, is considerably less than the number reported in commercial directories. This apparent discrepancy is due to the fact that in collecting the census statistics when a number of plants were operated under the same ownership it often was impracticable to secure a separate report for each, and therefore a single report was made to cover the operations of all and they were counted as one plant. In preparing the directories apparently each plant is treated as a separate unit. Although the number of stations in this report is less than the number accounted for in the directories, this difference is due to the census definition of the term "station," which may represent a single electric station or a number of stations which have been combined under the same ownership. These combinations embrace stations of varying characteristics as to primary power, generating and line equipment, and character of service. They have in common, however, the practice of disposing of electrical energy, either direct to consumers for light, heat, or power, or in bulk to some other public-service corporation. All or only a part of the stations embraced in a combination may have generating equipment, or the combination may embrace several generating stations which send the electrical energy over transmission lines to a single distributing center.

From year to year more or less of the central electric stations are merged with electric railways. These stations, nevertheless, are properly enumerated in the directories as separate stations, but are included in the census reports as a part of the electric railway industry except when separate reports can be prepared for the electric light and power departments.

Centralization.—The tendency toward centralization of ownership of electric stations noticeable in 1907 is even more pronounced in 1912.

Central electric stations reported at one census are sometimes combined and reported with electric railways at another census to an extent which actually destroys the comparability of the statistics in certain particulars for the individual states and, although it may not be perceptible, necessarily affects the total for the United States. The rapid development of the hydroelectric stations, many of which send current over long transmission lines, taking no cognizance of state boundaries, is another disturbing factor in the presentation of comparative statistics for the different states.

Commercial and municipal stations.—Central electric stations are divided into two groups—commercial and municipal. The commercial stations are those operated by individuals, firms, and corporations as distinguished from stations operated by municipalities.

The municipal stations often extend their operations into the commercial field and sell electricity to the general consumer.

Purely electric and composite stations.—Central stations are further classified as "purely electric" and "composite." The purely electric stations embrace those engaged solely in the generation and sale of electrical energy. The composite electric stations include those operated by companies which carry on other industries in connection with the stations, such as the manufacture of gas, the operation of waterworks, electric railways, ice plants, and other commercial enterprises. In some cases a company had but one system of accounts, rendering it impracticable to obtain exact statistics covering the operations of the central electric station. If the outside business was merely incidental to the operations of the central station the report was accepted, with or without the other business, in accordance with the system of accounting used by the reporting company. In cases where the outside business was of importance, careful estimates were obtained, so that the statistics would represent only the operations of the electric station. In connection with this latter class of station, however, it was sometimes impracticable satisfactorily to segregate the items on the balance sheet, and in such cases this inquiry, therefore, covers both the electrical and other business.

When income was reported for steam heating, usually from surplus steam, no attempt was made to segregate this business from that of electric station work; and, since the sale of electrical supplies and the wiring of buildings, etc., forms a part of the business of many companies, such income was included. Income of this character, however, is invariably reported as income from "All other sources."

Free service included as income.—It frequently happens that no cash income is derived by municipal stations for electrical energy used for lighting streets and public buildings. In order, however, that the income shown in this report might correspond approximately to the total consumption of electrical energy for all stations, the schedule required that the income for service of this character furnished by municipal stations be estimated on the basis of what would have been charged for similar service by commercial companies in near-by localities. Commercial companies sometimes rendered free service in consideration of franchise or other privileges, and the income for this service also was estimated in like manner and included in the total.

Comparison with prior censuses.—A partial census of the central electric stations was made in connection with the census of manufactures of 1890. It was found possible, however, to canvass only the state of New York and the city of St. Louis. The results, therefore, are too incomplete for comparison with later censuses. The first complete census of the industry was taken in 1902, and comparative statistics are confined to that year, 1907, and 1912. Substantially the same form of schedule was used at these three censuses. In formulating the schedule for 1912, however, it was deemed advisable to omit some of the subinquiries used at prior censuses because the statistics secured from these inquiries were not entirely satisfactory. The most important change affecting the comparability of the statistics relates to the number of persons employed. For the censuses of 1902 and 1907 the average number employed during the entire year was reported; the schedule of 1912 called for the number employed on September 16, and if statistics were not available for that day or month, data were obtained for the nearest representative or normal day. For the majority of establishments it was impossible to obtain a correct average of the number employed during the entire year, and it was believed that obtaining the number on a specified day would result in greater uniformity, also that this number would not vary greatly from the average number if the average was correctly computed. In many instances it is difficult to classify the employees according to the work upon which they are engaged, and in preparing the schedule for the census of 1912 it was decided to attempt only two groupings of employees, namely, salaried employees and wage earners.

There was considerable variation in reporting the number of lamps in public buildings. Some central stations considered the lamps in theaters, churches, schools, and similar buildings as installed in public buildings; others limited the number of this class to those installed in municipal buildings only. The income received from lighting municipal buildings is not, therefore, comparable with the number of lamps reported for public buildings.

There is no uniform system of accounts employed by all central electric stations, and it was difficult to obtain financial statistics on a uniform basis for all establishments enumerated. The National Electric Light Association has devised a system of accounts which it is endeavoring to have adopted by all stations. This system of accounts was followed as closely as possible in devising the schedule for the census of 1912. The schedule includes certain details in regard to financial transactions which were not shown definitely at prior censuses, and a much more satisfactory report in this respect has been made than was possible heretofore.

CHAPTER II.

DEVELOPMENT OF THE INDUSTRY.

Summary for 1912.—Table 1 is a summary for the central electric stations included in the census of 1912. It shows the principal facts ascertained at this census, and distinguishes two classes of stations: (1) Commercial central electric stations, those which are conducted by corporations, companies, and individuals; and (2) municipal electric stations, those which are operated by municipalities. It also shows the proportion that the totals for each of these classes of stations form of the total for all.

Table 1	Total.	Commercial stations.	Municipal stations.	PER CENT OF TOTAL.	
				Commercial.	Municipal.
Number of stations	5,221	3,659	1,562	70.1	29.9
Total income	$302,115,599	$278,896,610	$23,218,989	92.3	7.7
Light, heat, and power, including free service	$286,980,858	$264,317,150	$22,663,708	92.1	7.9
All other sources	$15,134,741	$14,579,460	$555,281	96.3	3.7
Total expenses, including salaries and wages[1]	$234,419,478	$217,502,313	$16,917,165	92.8	7.2
Total number of persons employed	79,335	71,395	7,940	90.0	10.0
Total horsepower	7,528,648	6,969,320	559,328	92.6	7.4
Steam engines and steam turbines—					
Number	7,844	5,820	2,024	74.2	25.8
Horsepower	4,946,532	4,539,866	406,666	91.8	8.2
Water wheels—					
Number	2,933	2,664	269	90.8	9.2
Horsepower	2,471,081	2,340,820	130,261	94.7	5.3
Gas and oil engines—					
Number	1,116	833	283	74.6	25.4
Horsepower	111,035	88,634	22,401	79.8	20.2
Kilowatt capacity of dynamos	5,134,689	4,766,012	368,677	92.8	7.2
Output of stations, kilowatt hours	11,532,963,006	10,995,436,276	537,526,730	95.3	4.7
Estimated number of lamps wired for service:					
Arc	505,395	413,544	91,851	81.8	18.2
Incandescent and other varieties	76,507,142	69,449,293	7,057,849	90.8	9.2
Stationary motors served:					
Number	435,472	413,578	21,895	95.0	5.0
Horsepower capacity	4,130,619	3,966,328	164,291	96.0	4.0

The income, horsepower of the prime movers, and the kilowatt capacity of dynamos are three important factors determining the magnitude of the central station industry. It appears from Table 1 that for the year 1912 the municipal stations reported a very small proportion of each of these items, the percentages being 7.7 for income, 7.4 for primary horsepower, and 7.2 for dynamo capacity. The commercial stations, therefore, largely predominated in the industry.

The municipal stations, however, show larger proportions for some of the other items contained in the table. Among the most conspicuous may be mentioned the number of stations, 29.9 per cent; the horsepower of gas and oil engines, 20.2 per cent; and number of arc lamps, 18.2 per cent. On the other hand, the municipal stations reported only 4.7 per cent of the kilowatt hour output for the year, and but 4 per cent of the horsepower of stationary motors served.

The statistics for the central stations do not represent the entire production and utilization of electrical energy. To arrive at the aggregate, it is necessary to consider also the electric railways, telephone and telegraph lines, electric police-patrol and fire-alarm systems, and isolated electric plants. All of these industries are engaged in the utilization of electric current in what may be termed commercial enterprises. Statistics for the total gross income are available for all of them except municipal police-patrol and fire-alarm systems and isolated electric plants. This gross income for the year 1912 amounted to $1,201,168,106, of which $302,115,599 was reported for central electric stations, $579,208,430 for electric railways, $255,081,234 for telephone systems, and $64,762,843 for telegraph systems (see table, p. 11).

Isolated electric stations.—Although, as stated in Chapter I, no attempt was made to collect statistics concerning isolated electric plants which are operated primarily for the benefit of their owners, for furnishing light or power for their factories, hotels, or other enterprises, the number and magnitude of these stations should necessarily be considered in connection with statistics showing the development of the central station industry. Some of these isolated stations that were excluded from the census are much larger than many of the central stations for which statistics are included. With the exception of the municipal stations, it was intended to confine the canvass for the census of 1912 to stations which make a business of disposing of electric current for commercial purposes, since it was impracticable within the time and means available to make a thorough canvass of all isolated plants. However, the special agents engaged in the field work collected reports from a few isolated plants, and some reports for such plants were secured by mail. These reports include a few stations of considerable magnitude, and while the data for them can in no sense be considered as an indication of the number or the magnitude of the operations of the isolated electric stations omitted from the canvass, nevertheless the figures for the 121 plants thus reported may be of interest, and they are summarized in the following statement:

Number of establishments	121
Total primary horsepower	102,187
Kilowatt capacity of dynamos	68,466
Estimated number of lamps wired for service, all varieties	152,958

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[1] In addition to salaries and wages, includes the cost of supplies and materials used for ordinary repairs and replacement, advertising, fuel, mechanical power, electrical energy purchased, taxes, charges for depreciation and charges for sinking fund, and all other expenses incident to operation and maintenance.

The 121 isolated plants covered by the above statement were operated in connection with a variety of industries, establishments, and institutions, such as mining, lumber mills, gristmills, hotels, office buildings, land improvement companies, cotton and woolen mills, schools, and colleges. The data cover but a small fraction of the isolated electric plants in the United States, and are representative of such plants more as an indication of the character of the establishments for which statistics have been excluded from the census than as an evidence of their capacity for the generation of electricity.

Central station work of electric railways.—Of the several electrical industries, electric railways is the one most closely identified with central electric stations. A number of electric railway companies were engaged in the sale of electric current for light and power, having special departments for such work, and were able, therefore, to make complete separate reports for this service. The statistics covered by the reports for such companies are included with those for central electric stations. In 1912 there were 169 electric railways that operated light and power plants for which they were unable to make separate reports.

The statistics for the central station work of these 169 plants are placed in comparison, in Table 2, with those of a similar character in 1907 and 1902.

Table 2 shows that while the number of electric railways doing central station work for which they could not prepare complete census reports has increased during the decade, there is a still greater increase in their importance. The total income for the light and power departments of these companies during 1912 amounted to $31,515,582, as compared with $6,469,726 in 1902, an increase of $25,045,856, or 387.1 per cent. In addition, there were a number of electric railway companies which were not able to furnish statistics of electric service of the character given in Table 2, but nevertheless reported an income from the sale of current amounting to $5,515,475. Some of the electric current was sold to other electric railway companies, but the larger portion was used for light and power in enterprises not connected with the railways. Combining the income from the sale of current by companies which had electric light and power departments with that for those not having such departments, the total income amounts to $36,500,030 in 1912, as compared with $7,703,574 in 1902.

Table 2	ELECTRIC LIGHT AND POWER DEPARTMENTS OF ELECTRIC RAILWAY COMPANIES.			
	1912	**1907**	**1902**	**Per cent of increase: 1902–1912**
Number of stations	169	177	118	43.2
Gross income	$31,515,582	$17,291,824	$6,469,726	387.1
Electric service	[1] $30,984,555	$16,576,555	$6,271,815	394.0
All other sources	$531,027	$715,269	$197,911	168.3
Estimated number of lamps wired for service:				
Arc	55,586	80,102	33,863	64.1
Incandescent and other varieties	9,109,890	4,574,480	1,442,685	531.5
Stationary motors:				
Number	(2)	20,468	10,049	....
Horsepower	(2)	158,923	35,688	....
Meters on consumption circuits, number	(2)	213,886	56,601	....

[1] Exclusive of the estimated value of free service, amounting to $66,051.
[2] Not reported.

Comparison of central electric stations and gas plants.—The manufacture of illuminating gas and the production of electricity for light and power virtually have the same field of operation, and with certain limitations they come in direct competition. For this reason a comparison of the statistics for the two industries is instructive as indicating the changes in the relative importance of each. The statistics for the central electric stations and the manufacture of illuminating gas as reported at the last three censuses of these industries are presented in Table 3, which follows:

COMPARATIVE SUMMARY—CENTRAL ELECTRIC STATIONS AND GAS PLANTS: 1912, 1907, AND 1902.

Table 3	CENTRAL ELECTRIC STATIONS.			GAS PLANTS.			PER CENT OF INCREASE.					
							Central electric stations.			Gas plants.		
	1912	**1907**	**1902**	**1909**	**1904**	**1899**	**1902–1912**	**1907–1912**	**1902–1907**	**1899–1909**	**1904–1909**	**1899–1904**
Number of stations or plants	5,221	4,714	3,620	1,296	1,019	877	44.2	10.8	30.2	47.8	27.2	16.2
Cost of construction and equipment	$2,175,678,266	$1,096,913,622	$504,740,352	[1] $915,536,762	[1] $725,035,204	[1] $567,000,506	331.0	98.3	117.3	61.5	26.3	27.9
Gross income[2]	$302,115,599	$175,642,338	$85,700,605	$166,814,371	$125,144,945	$75,716,693	252.5	72.0	104.9	120.3	33.3	65.3
From sale of electric current or gas	$286,980,858	$169,614,691	$84,186,605	$138,615,309	$112,662,568	$69,432,582	240.9	69.2	101.5	99.6	23.0	62.3
From all other sources	$15,134,741	$6,027,647	$1,514,000	$28,199,062	$12,482,377	$6,284,111	899.7	151.1	298.1	348.7	125.9	98.6
Total number of persons employed	79,335	47,632	30,326	50,730	39,972	28,363	161.6	66.6	57.1	78.9	26.9	40.9

[1] Capital invested—owned and borrowed.
[2] Exclusive of the income reported by the electric light and power departments of electric railways, as follows: In 1912, $31,515,582; in 1907, $17,291,824; and in 1902, $6,469,726.

Although the statistics for the two industries in Table 3 do not cover the same years, they represent the results of three censuses taken at five-year intervals, the respective census years being sufficiently near together for the purpose of general comparison. They do not, of course, show exactly the relative importance of the industries because of the absence of statistics for isolated plants, which are of much greater importance in the electrical industry than in the manufacture of gas.

The percentages of increase for central electric stations are about double what they are for the gas industry. This condition is due largely to the fact that the electrical industry in 1902 was practically in its infancy, whereas the gas industry in 1899 was well established. The income from the sale of electric current increased by 240.9 per cent during the decade ending with 1912, as compared with an increase of 99.6 per cent in the income from the sale of gas. Of the total combined income of the two industries for the earliest years shown, that reported by the electrical industry formed 54.8 per cent and that for the gas industry 45.2 per cent, while for the last years shown the corresponding percentages were 67.4 and 32.6, respectively. In addition to the income for electric stations, the corresponding item reported by electric railway companies should be considered. This amounted to $36,500,030 for 1912, thus increasing the total gross receipts from the sale of current to $323,480,888. This total, however, includes receipts from the sale of current to other public-service corporations, amounting to $31,019,660 for central stations and $7,580,535 for electric railways, or $38,600,195 in all. The elimination of this duplication from the total reduces the gross receipts from the sale of current in 1912 to $284,880,693.

Central electric stations and population.—A comparison of the number of central electric stations, their equipment, and their output with the population is one of the most satisfactory methods of illustrating the development of the industry. The advances made in long-distance transmission of electricity and its application to industrial processes in rural districts as well as in cities have stimulated the development of central stations. These advances have made it possible for the population of a much larger area to obtain the advantages of electric service. At the same time central stations are naturally established in localities from which a large population can be served most economically. A correct comparison of the population and central station work should be confined to the population within the actual radius of the service. It is impossible, however, to establish such a radius, and therefore in Table 4 the statistics for number of stations, horsepower of prime movers, kilowatt capacity of dynamos, output of stations, and number of lamps are compared with the entire population of the United States and the geographic divisions for 1912, 1907, and 1902.

CENTRAL ELECTRIC STATIONS—RELATION OF LEADING ITEMS TO POPULATION, BY GEOGRAPHIC DIVISIONS: 1912, 1907, AND 1902.

Table 4

DIVISION.[1]	Census.	Population.[2]	NUMBER OF STATIONS.			HORSEPOWER OF ENGINES AND WATER WHEELS.[3]		KILOWATT CAPACITY OF DYNAMOS.		OUTPUT OF STATIONS, KILOWATT HOURS.		LAMPS.[4]			
												Arc.		Incandescent.	
			Total.	Commercial.	Municipal.	Amount.	Per 1,000 population.	Amount.	Per 1,000 population.	Amount.	Per 1,000 population.	Estimated number.	Per 1,000 population.	Estimated number.	Per 1,000 population.
United States..	1912	95,545,336	5,221	3,659	1,562	7,528,648	79	5,134,689	54	11,532,963,006	120,707	505,395	5.3	76,484,096	800
	1907	85,532,761	4,714	3,462	1,252	4,098,188	48	2,709,225	32	5,862,276,737	68,538	555,713	6.5	41,445,997	485
	1902	78,576,436	3,620	2,805	815	1,845,048	23	1,212,235	15	2,507,051,115	31,906	385,698	4.9	18,194,044	232
North Atlantic......	1912	26,946,884	1,037	878	159	2,748,561	102	1,893,700	70	4,427,877,840	164,319	226,264	8.4	30,051,802	1,115
	1907	23,779,013	1,070	920	150	1,534,586	65	1,054,528	44	2,483,106,227	104,424	242,320	10.2	17,187,474	723
	1902	21,778,196	913	810	103	814,728	37	517,549	24	1,269,331,001	58,284	169,554	7.8	8,561,205	393
South Atlantic......	1912	12,586,562	512	308	204	621,114	49	412,779	33	679,856,425	54,014	21,389	1.7	3,886,979	309
	1907	11,574,988	390	232	158	295,265	26	195,309	17	266,437,175	23,018	27,103	2.3	1,915,725	166
	1902	10,770,414	251	176	75	92,641	9	62,301	6	102,990,575	9,562	17,183	1.6	611,001	57
North Central.......	1912	30,683,662	2,337	1,464	873	2,292,749	75	1,580,700	52	3,240,559,539	105,612	178,902	5.8	26,918,022	877
	1907	29,026,645	2,095	1,368	727	1,219,916	42	805,012	28	1,462,114,001	50,371	204,248	7.0	14,269,544	492
	1902	27,087,206	1,706	1,178	528	539,669	20	375,514	14	645,062,113	23,814	145,529	5.4	6,176,919	228
South Central.......	1912	17,890,901	837	587	250	449,294	25	308,411	17	461,612,464	25,802	38,010	2.1	5,432,834	304
	1907	16,368,558	679	513	166	244,422	15	165,969	10	257,387,610	15,725	39,794	2.4	2,697,115	165
	1902	14,651,535	404	323	81	117,192	8	82 259	6	153,905,350	10,504	23,320	1.6	1,022,298	70
Western.............	1912	7,437,327	498	422	76	1,416,930	191	939,099	126	2,723,056,738	366,134	40,830	5.5	10,194,459	1,371
	1907	4,783,557	480	429	51	803,999	168	488,407	102	1,393,231,724	291,254	42,248	8.8	5,376,139	1,124
	1902	4,289,085	346	318	28	280,818	65	174,612	41	335,762,076	78,283	30,112	7.0	1,822,621	425

[1] See page 25 for states composing the several geographic divisions.

[2] Bureau of the Census estimates.

[3] Includes capacity of auxiliary engines, amounting to 65,823 horsepower in 1907 and 14,454 horsepower in 1902.

[4] Exclusive of "Other varieties," Nernst, vacuum, vapor, etc., 23,046 in 1912, and 162,338 in 1907. Also exclusive of 275,079 lamps in 1907 used by the central stations to light their own properties, these lamps being included in 1912 and 1902, though not separately reported.

As might be expected, the largest numbers of central electric stations, with correspondingly high figures for primary horsepower and kilowatt capacity of dynamos, are found in the most populous sections. This is well illustrated by the totals for the North Atlantic and the North Central divisions, which combined represented 62.2 per cent of the estimated population in 1902 and 60.3 per cent in 1912. These two divisions reported 73.4 per cent of the total primary horsepower in 1902 and 67 per cent in 1912; and of the kilowatt capacity of the dynamos, 73.7 per cent and 67.7 per cent, respectively. For the South Atlantic and the South Central divisions, however, the proportion of population was practically double the proportions for these two items.

In the Western division the general rule as to the proportion of electrical equipment to population does not hold. This division, which had 5.5 per cent of the population in 1902 and 7.8 per cent in 1912, reported for these two years, respectively, of the primary horsepower, 15.2 per cent and 18.8 per cent; and of the kilowatt capacity of the dynamos, 14.4 per cent and 18.3 per cent. The Western division had, in 1912, but 7,437,327 inhabitants, or 7.8 per cent of the total population of the United States, as compared with 26,946,884, or 28.2 per cent, for the North Atlantic; 12,586,562, or 13.2 per cent, for the South Atlantic; 30,683,662, or 32.1 per cent, for the North Central; and 17,890,901, or 18.7 per cent, for the South Central division; and yet the Western division, the smallest of the five in population, was third in all of the main factors of central station equipment and first in all of the proportions shown per 1,000 population, except for arc lamps, in respect to which this division was third.

It is noticeable in this connection that the proportions per 1,000 population for arc lamps, for the United States and for each of the geographic divisions, which had increased from 1902 to 1907, decreased from 1907 to 1912. For each of the other factors mentioned there was an increased proportion from census to census.

Commercial and municipal stations combined.—The statistics for the central electric station industry as a whole, commercial and municipal stations combined, as reported at the censuses of 1912, 1907, and 1902, are presented in Table 5. This table shows the percentages of increase for the decade and for the two five-year periods.

The 5,221 central stations shown in Table 5 should not be accepted as the number of separate plants. As explained in the introduction, the census reports in some instances include statistics for a number of plants operated under the same ownership, and reports for such combination of stations have been considered and treated as reports for single stations. There was, however, an increase in the number of central stations, but a much greater gain in the magnitude of their operations, during the decade ending with 1912. The most notable increases are those in primary horsepower, kilowatt capacity of the dynamos, the output of the stations, and the horsepower capacity of the stationary motors served. The percentages of increase were more pronounced during the five years ending with 1907. During this period the gross income of central stations increased by 104.9 per cent, as compared with 72 per cent for the five years from 1907 to 1912, and 252.5 per cent for the decade.

The income reported for 1912 exceeded that for 1902 by $216,414,994. Of this increase, $202,794,253, or 93.7 per cent, represents receipts from electric service, and $13,620,741, or 6.3 per cent, from all other sources, such as steam heating, profits on merchandise sales, rentals, etc.

During the decade primary power increased by 5,683,600 horsepower, or 308 per cent, while the dynamo capacity increased by 3,922,454 kilowatts, or 323.6 per cent, and the output of stations by 9,025,911,891 kilowatt hours, or 360 per cent.

Table 5

	COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS.					
	1912	1907	1902	Per cent of increase.[1]		
				1902-1912	1907-1912	1902-1907
Number of stations [2]	5,221	4,714	3,620	44.2	10.8	30.2
Commercial	3,659	3,462	2,805	30.4	5.7	23.4
Municipal	1,562	1,252	815	91.7	24.8	53.6
Total income [3]	$302,115,599	$175,642,338	$85,700,605	252.5	72.0	104.9
Light, heat, and power, including free service	$286,980,858	$169,614,691	$84,186,605	240.9	69.2	101.5
All other sources	$15,134,741	$6,027,647	$1,514,000	899.7	151.1	298.1
Total expenses, including salaries and wages [4]	$234,419,478	$134,196,911	$68,081,375	244.3	74.7	97.1
Total number of persons employed	79,335	47,632	30,326	161.6	66.6	57.1
Total horsepower	7,528,648	4,098,188	1,845,048	308.0	83.7	122.1
Steam engines and steam turbines [5]—						
Number	7,844	8,054	6,295	24.6	−2.6	27.9
Horsepower	4,946,532	2,693,273	1,394,395	254.7	83.7	93.1
Water wheels—						
Number	2,933	2,481	1,390	111.0	18.2	78.5
Horsepower	2,471,081	1,349,087	438,472	463.6	83.2	207.7
Gas and oil engines—						
Number	1,116	463	165	576.4	141.0	180.6
Horsepower	111,035	55,828	12,181	811.5	98.9	358.3
Kilowatt capacity of dynamos	5,134,689	2,709,225	1,212,235	323.6	89.5	123.5
Output of stations, kilowatt hours	11,532,963,006	5,862,276,737	2,507,051,115	360.0	96.7	133.8
Estimated number of lamps wired for service:						
Arc	505,395	[6] 562,795	385,698	31.0	−10.2	45.9
Incandescent and other varieties	76,507,142	[6] 41,876,332	18,194,044	320.5	82.7	130.2
Stationary motors served:						
Number	435,473	167,184	101,064	330.9	160.5	65.4
Horsepower capacity	4,130,619	1,649,026	438,005	843.1	150.5	276.5

[1] A minus sign (—) denotes decrease.

[2] The term "station" as here used may represent a single electric station or a number of stations operated under the same owership.

[3] Exclusive of $36,500,030 in 1912, $20,093,302 in 1907, and $7,703,574 in 1902, reported by street and electric railway companies as income from sale of electric current for light or power or from sale of current to other public-service corporations.

[4] In addition to salaries and wages, includes the cost of supplies and materials used for ordinary repairs and replacement, advertising, fuel, mechanical power, electrical energy purchased, taxes, charges for depreciation, and all other expenses incident to operation and maintenance.

[5] Includes auxiliary engines.

[6] Includes, for purposes of comparison, 7,082 arc and 267,997 incandescent lamps reported by the electric companies to light their own properties. Lamps used for such service were included in the total number reported in 1912 and 1902.

Commercial central electric stations.—As shown by Table 1, the commercial central electric stations largely predominate over the municipal stations in number and capacity. Table 6 is a comparative summary of the statistics for commercial central stations as reported for 1912, 1907, and 1902.

The commercial stations represent such a large proportion of the industry that the conditions prevailing in them are necessarily reflected in the totals for both classes of stations. The percentages of increase, therefore, harmonize with those shown in Table 5 for both classes of stations. The gross income derived by commercial stations from the sale of electricity and from other sources combined, in 1912, was more than three and one-half times that reported for 1902. The horsepower of the engines and water wheels, the kilowatt capacity of the dynamos, and the output of stations increased more than threefold during this period.

Table 6	COMMERCIAL CENTRAL ELECTRIC STATIONS.					
	1912	1907	1902	Per cent of increase.[1]		
				1902-1912	1907-1912	1902-1907
Number of stations	3,659	3,462	2,805	30.4	5.7	23.4
Total income	$278,896,610	$161,630,339	$78,735,500	254.2	72.6	105.3
Light, heat, and power, including free service	$264,317,150	$156,000,257	$77,349,749	241.7	69.4	101.7
All other sources	$14,579,460	$5,630,082	$1,385,751	952.1	159.0	306.3
Total expenses, including salaries and wages[2]	$217,502,313	$123,880,291	$62,835,388	246.1	75.6	97.2
Total number of persons employed	71,395	42,066	26,909	165.3	69.7	56.3
Total horsepower	6,969,320	3,776,837	1,685,020	313.6	84.5	124.1
Steam engines and steam turbines[3]—						
Number	5,820	6,268	5,199	11.9	−7.1	20.6
Horsepower	4,539,866	2,408,351	1,246,542	264.2	88.5	93.2
Water wheels—						
Number	2,664	2,328	1,308	103.7	14.4	78.0
Horsepower	2,340,820	1,318,740	427,254	447.9	77.5	208.7
Gas and oil engines—						
Number	833	385	147	466.7	116.4	161.9
Horsepower	88,634	49,746	11,224	689.7	78.2	343.2
Kilowatt capacity of dynamos	4,766,012	2,500,209	1,098,855	333.7	90.6	127.5
Output of stations, kilowatt hours	10,995,436,276	5,572,813,949	2,311,146,676	375.8	97.3	141.1
Estimated number of lamps wired for service:						
Arc	413,544	[4] 479,260	334,903	23.5	−13.7	43.1
Incandescent and other varieties	69,449,293	[4] 37,786,435	16,616,593	318.0	83.8	127.4
Stationary motors served:						
Number	413,578	162,677	99,102	317.3	154.2	64.2
Horsepower capacity	3,966,328	1,617,337	434,681	812.5	145.2	272.1

[1] A minus sign (—) denotes decrease.

[2] In addition to salaries and wages, includes the cost of supplies and materials used for ordinary repairs and replacement, advertising, fuel, mechanical power, electrical energy purchased, taxes, charges for depreciation, and all other expenses incident to operation and maintenance.

[3] Includes auxiliary engines.

[4] Includes, for purposes of comparison, 6,487 arc and 239,418 incandescent lamps reported by the electric companies to light their own properties. Lamps used for such service were included in the total number reported in 1912 and 1902.

Ownership of commercial central electric stations.—Changes in the form of ownership of commercial central stations are an interesting feature of the development of the industry. The statistics in Table 7, which follows, show the importance of the different forms of ownership of commercial stations as reported for the censuses of 1912 and 1907, together with the percentages of increase in the totals for each.

The preponderance and growing importance of stations under corporate form of ownership are clearly shown by this table. Practically all of the large commercial stations are owned by incorporated companies. The 2,779 stations reported for this form of ownership in 1912, however, contain a number of small plants, many of which are smaller than some of those operated by individuals or firms. Except in the case of gas and oil engines, which are peculiarly adapted to the requirements of the small station, the percentages of increase for the several items were greatest for stations under corporate ownership. In 1912 the stations owned by corporations and which constituted three-fourths of the total number (75.9 per cent) reported 98.4 per cent of the total income, 98.1 per cent of the horsepower, 98.1 per cent of the dynamo capacity, and 99.1 per cent of the kilowatt-hour output shown for all stations. Not only do the operations of the stations owned by individuals and firms represent a comparatively small proportion of the central station business, but there was a decrease in their proportion of the essential features of the industry in 1912, as compared with 1907, together with an actual falling off in their number.

COMMERCIAL CENTRAL ELECTRIC STATIONS, BY CHARACTER OF OWNERSHIP: 1912 AND 1907.

Table 7	TOTAL.		INDIVIDUAL.		FIRM.		INCORPORATED.[1]		PER CENT OF INCREASE.[2]			
	1912	1907	1912	1907	1912	1907	1912	1907	Total.	Individual.	Firm.	Incorporated.
Number of stations	3,659	3,462	587	609	293	298	2,779	2,555	5.7	−3.6	−1.7	8.8
Total income	$278,896,610	$161,630,339	$2,931,706	$2,371,467	$1,575,096	$1,478,134	$274,389,808	$157,780,738	72.6	23.6	6.6	73.9
Light, heat, and power	$264,317,150	$156,000,257	$2,812,178	$2,262,102	$1,517,129	$1,408,139	$259,987,843	$152,330,016	69.4	24.3	7.7	70.7
All other sources	$14,579,460	$5,630,082	$119,528	$109,365	$57,967	$69,995	$14,401,965	$5,450,722	159.0	9.3	−17.2	164.2
Total expenses, including salaries and wages	$217,502,313	$97,037,961	$2,155,032	$1,615,426	$1,109,031	$1,021,788	$214,238,250	$94,400,747	124.1	33.4	8.5	126.9
Total number of persons employed	71,395	42,066	1,097	1,034	576	634	69,722	40,398	69.7	6.1	−9.1	72.6
Total horsepower	6,969,320	3,776,837	87,455	74,668	48,404	47,025	6,833,461	3,655,144	84.5	17.1	2.9	87.0
Steam engines (including turbines):[3]												
Number	5,820	6,268	479	555	255	296	5,086	5,417	−7.1	−13.7	−13.9	−6.1
Horsepower	4,539,866	2,408,351	57,234	52,340	29,717	30,669	4,452,915	2,325,342	88.5	9.4	−3.1	91.5
Water wheels:												
Number	2,664	2,328	198	209	100	103	2,366	2,016	14.4	−5.3	−2.9	17.4
Horsepower	2,340,820	1,318,740	22,141	18,751	14,151	14,957	2,304,528	1,285,032	77.5	18.1	−5.4	79.3
Gas and oil engines:												
Number	833	385	192	83	110	37	531	265	116.4	131.3	197.3	100.4
Horsepower	88,634	49,746	8,080	3,577	4,536	1,399	76,018	44,770	78.2	125.9	224.2	69.8
Kilowatt capacity of dynamos	4,766,012	2,500,209	60,023	44,315	29,577	28,511	4,676,412	2,427,383	90.6	35.4	3.7	92.7
Output of stations, kilowatt hours	10,995,436,276	5,572,813,949	60,058,813	43,103,493	37,951,228	41,357,746	10,897,426,235	5,488,352,710	97.3	39.3	−8.2	98.6
Estimated number of lamps wired for service:[4]												
Arc	413,544	472,773	3,360	5,758	1,471	3,021	408,713	463,994	−12.5	−41.6	−51.3	−11.9
All other varieties	69,449,293	37,547,017	896,976	737,219	449,826	406,471	68,102,491	36,403,327	85.0	21.7	10.7	87.1

[1] In 1912 includes 7 stations classed as "other forms of ownership," and in 1907 two such stations, in order to avoid the disclosure of individual operations.

[2] A minus sign (—) denotes decrease.

[3] Includes auxiliary engines.

[4] In 1907 exclusive of 275,079 lamps used by the central stations to light their own properties. Lamps used for such service were not reported separately in 1912.

Municipal central electric stations.—Although, as shown by Table 1, the municipal electric stations form a comparatively small proportion of the total central electric station industry, nevertheless this class of stations has been increasing rapidly during the past decade. The statistics for them, as reported at the censuses of 1912, 1907, and 1902, are summarized in Table 8.

Table 8 MUNICIPAL CENTRAL ELECTRIC STATIONS.

	1912	1907	1902	Per cent of increase. 1902–1912	1907–1912	1902–1907
Number of stations	1,562	1,252	815	91.7	24.8	53.6
Total income	$23,218,989	$14,011,999	$6,965,105	233.4	65.7	101.2
Light, heat, and power, including free service	$22,663,708	$13,614,434	$6,836,856	231.5	66.5	99.1
All other sources	$555,281	$397,565	$128,249	333.0	39.7	210.0
Total expenses, including salaries and wages [1]	$16,917,165	$10,316,620	$5,245,987	222.5	64.0	96.7
Total number of persons employed	7,940	5,566	3,417	132.4	42.7	62.9
Total horsepower	559,328	321,351	160,028	249.5	74.1	100.8
Steam engines and steam turbines [2]—						
Number	2,024	1,786	1,096	84.7	13.3	63.0
Horsepower	406,666	284,922	147,853	175.0	42.7	92.7
Water wheels—						
Number	269	153	82	228.0	75.8	86.6
Horsepower	130,261	30,347	11,218	1,061.2	329.2	170.5
Gas and oil engines—						
Number	283	78	18	1,472.2	262.8	333.3
Horsepower	22,401	6,082	957	2,240.8	268.3	535.5
Kilowatt capacity of dynamos	368,677	209,016	113,380	225.2	76.4	84.3
Output of stations, kilowatt hours	537,526,730	289,462,788	195,904,439	174.4	85.7	47.8
Estimated number of lamps wired for service:						
Arc	91,851	[3] 83,535	50,795	80.8	10.0	64.5
Incandescent and other varieties	7,057,849	[3] 4,089,897	1,577,451	347.4	72.6	159.3
Stationary motors served:						
Number	21,895	4,507	1,962	1,016.0	385.8	129.7
Horsepower capacity	164,291	31,689	3,324	4,842.6	418.4	853.3

[1] In addition to salaries and wages, includes the cost of supplies and materials used for ordinary repairs and replacement, advertising, fuel, mechanical power, electrical energy purchased, taxes, charges for depreciation, and all other expenses incident to operation and maintenance.

[2] Includes auxiliary engines.

[3] Includes, for purposes of comparison, 595 arc and 28,579 incandescent lamps reported by the electric companies to light their own properties. Lamps used for such service were included in the total number reported in 1912 and 1902.

Table 8 shows exceptionally large percentages of increase during the decade in the horsepower of water wheels, gas and oil engines, and stationary motors served by municipal stations. These percentages, however, are based on comparatively small figures and are apt to be misleading. Except in the case of the number of stations, number of arc lamps, and horsepower of gas and oil engines, more than nine-tenths of the various items covered in Table 8 are reported by commercial stations. The relative importance of the commercial and municipal stations in 1912, 1907, and 1902 is shown by the following statement:

	PER CENT OF TOTAL, COMMERCIAL AND MUNICIPAL STATIONS. Commercial. 1912	1907	1902	Municipal. 1912	1907	1902
Number of stations	70.1	73.4	77.5	29.9	26.6	22.5
Total income	92.3	92.0	91.9	7.7	8.0	8.1
Light, heat, and power, including free service	92.1	92.0	91.9	7.9	8.0	8.1
All other sources	96.3	93.4	91.5	3.7	6.6	8.5
Total expenses, including salaries and wages	92.8	92.3	92.3	7.2	7.7	7.7
Total number of persons employed	90.0	88.3	88.7	10.0	11.7	11.3
Total horsepower	92.6	92.2	91.3	7.4	7.8	8.7
Steam engines and steam turbines	91.8	89.4	89.4	8.2	10.6	10.6
Water wheels	94.7	97.8	97.4	5.3	2.2	2.6
Gas and oil engines	79.8	89.1	92.1	20.2	10.9	7.9
Kilowatt capacity of dynamos	92.8	92.3	90.6	7.2	7.7	9.4
Output of stations, kilowatt hours	95.3	95.1	92.2	4.7	4.9	7.8
Estimated number of lamps wired for service:						
Arc	81.8	85.2	86.8	18.2	14.8	13.2
Incandescent and other varieties	90.8	90.2	91.3	9.2	9.8	8.7
Stationary motors served:						
Number	95.0	97.3	98.1	5.0	2.7	1.9
Horsepower capacity	96.0	98.1	99.2	4.0	1.9	0.8

Considerable interest attaches to the increase in number and capacity of municipal stations. The establishment of such stations, as a rule, has been brought about by public vote, because of the inability to establish and operate a commercial station, or because of dissatisfaction with the service furnished by such a station. Of particular significance, therefore, is the change in the form of ownership from private to municipal, or vice versa. This feature is developed in Table 9, which shows the number of municipal stations in 1912 and 1907, with the net numerical increase during the five years, and summarizes the several changes which have brought about the total increase. The figures are shown separately for the nine geographic divisions of the United States.

Table 9 NUMBER OF MUNICIPAL CENTRAL ELECTRIC STATIONS AND INCREASE, BY GEOGRAPHIC DIVISIONS: 1907 TO 1912.

DIVISION.[1]	Number of stations. 1912	1907	Numerical increase.	New stations since 1907.	From commercial stations in 1907 to municipal in 1912.	From municipal stations in 1907 to commercial in 1912.	Active municipal stations in 1907 that were out of business or not operated in 1912.
United States	1,562	1,252	310	301	106	80	17
New England	57	51	6	6	1	1	....
Middle Atlantic	102	99	3	10	1	7	1
East North Central	474	453	21	34	26	30	[2] 9
West North Central	399	274	125	109	31	13	2
South Atlantic	204	158	46	50	14	14	4
East South Central	128	109	19	18	6	5	....
West South Central	122	57	65	51	18	3	1
Mountain	39	20	19	15	5	1	....
Pacific	37	31	6	8	4	6	....

[1] See page 25 for states composing the several geographic divisions.

[2] Includes 4 municipal stations that since 1907 have been merged with other municipal stations.

There was a numerical increase of 310 in the number of municipal stations reported for 1912 as compared with 1907, while, as shown by Table 6, there was an increase of only 197 in the number of commercial stations. However, the practice of including in census reports data for a number of commercial stations operated under the same ownership, as explained in Chapter I, does not prevail in the case of municipal stations. Therefore the number of such stations (1,562) reported for 1912 is practically the number of separate plants in operation during that year. The great increase in the number of municipal stations is due to the fact that there were 301 reported for 1912 that had been built since 1907. There was an additional increase of 9 stations, brought about by the difference between the number of stations (106), on the one hand, whose ownership had changed from commercial in 1907 to municipal in 1912, and, on the other hand, 80 stations which had changed in the opposite direction, from municipal to commercial, and 17 that had gone out of business during the period between the censuses or were not reported as in operation in 1912. The West South Central geographic division shows the largest percentage of increase in the number of stations during the five-year period covered by the table, but the largest numerical increase (125) is shown for the West North Central division.

Municipal stations, by population groups of cities.—The statistics for commercial central stations can not be shown for cities, because in many instances these stations furnish current to two or more communities as well as to the surrounding territory, and also because a number of these stations are located outside the corporate limits of cities and furnish electricity to the surrounding regions irrespective of political subdivisions. Although such conditions prevail to some extent among the municipal stations, it is not believed to be of sufficient consequence to affect materially the general accuracy of the statistics for cities grouped according to the population of the cities.

In Table 10, therefore, detailed statistics are given for municipal electric stations by population groups of cities for 1912, 1907, and 1902.

By far the most numerous class of stations consists of those in places of less than 5,000 population. There were 1,327 of these stations in 1912, or 85 per cent of all municipal stations, compared with 671, or 82.3 per cent, in 1902—a gain during the decade of 656, or 97.8 per cent.

MUNICIPAL CENTRAL ELECTRIC STATIONS, BY POPULATION OF CITIES IN WHICH LOCATED AND BY GEOGRAPHIC DIVISIONS: 1912, 1907, AND 1902.

Table 10

DIVISION[1] AND POPULATION GROUP.	Census.	Number of stations.	Cost of construction and equipment.	INCOME.			Total expenses.	Total primary horsepower.	KILOWATT CAPACITY OF DYNAMOS.			Output of stations, kilowatt hours.	ESTIMATED NUMBER OF LAMPS WIRED FOR SERVICE.	
				Total.	Electric service.	All other sources.			Total.	Direct current, constant voltage and amperage.	Alternating and polyphase current.		Arc.	Incandescent and all other varieties.
Total	1912	1,562	$77,065.144	$23,218,989	$22,663,708	$555,281	$16,917,165	559,328	368,677	44,564	324,113	537,526,730	91,851	7,057,849
	1907	1,252	42,879,447	14,011,999	13,614,434	397,565	[2] 9,167,188	321,351	209,016	45,993	163,023	289,462,788	82,940	4,061,318
	1902	815	22,020,473	6,965,105	6,836,856	128,249	[2] 4,741,182	160,028	113,380	45,727	67,653	195,904,439	50,795	1,577,451
Under 5,000	1912	1,327	31,349,806	11,026,579	10,678,780	347,799	8,412,993	257,384	172,705	25,803	146,902	186,294,678	23,069	3,895,703
	1907	1,081	21,476,667	7,631,842	7,337,260	294,582	5,298,119	194,172	130,174	27,355	102,819	146,906,359	30,888	2,722,519
	1902	671	11,074,008	3,621,023	3,538,468	82,555	2,620,167	96,282	64,650	20,679	43,971	105,518,293	19,611	1,094,946
5,000 but under 25,000.	1912	189	15,953,305	6,014,722	5,861,287	153,435	4,103,721	128,506	91,696	7,030	84,666	127,432,560	19,976	2,010,446
	1907	142	9,726,310	3,466,142	3,389,192	76,950	2,128,859	75,975	48,107	7,708	40,399	78,788,119	23,033	954,532
	1902	121	5,605,178	1,765,000	1,732,897	32,103	1,212,636	40,123	28,966	10,492	18,474	56,286,059	15,701	391,645
25,000 but under 100,000.	1912	31	8,304,604	2,822,984	2,792,212	30,772	2,032,825	91,327	62,341	2,371	59,970	65,838,060	15,537	652,059
	1907	17	4,823,033	1,414,810	1,408,521	6,289	778,358	25,763	14,812	3,407	11,405	29,815,562	9,549	329,286
	1902	13	1,553,931	455,204	455,149	55	315,139	7,713	5,394	2,819	2,575	8,929,900	4,800	66,840
100,000 but under 500,000.	1912	7	8,559,566	1,584,082	1,575,596	8,486	1,095,607	47,255	27,064	844	26,220	61,120,808	12,576	368,118
	1907	6	2,760,732	736,276	716,532	19,744	373,750	12,616	8,250	2,240	6,010	17,819,478	8,393	43,036
	1902	6	1,607,803	441,235	427,699	13,536	255,606	6,085	4,263	2,869	1,394	9,543,807	4,544	21,620
500,000 and over	1912	8	12,897,863	1,770,622	1,755,833	14,789	1,272,019	34,856	14,871	8,516	6,355	96,840,624	20,693	131,523
	1907	6	4,092,705	762,929	762,929	....	588,102	12,825	7,673	5,283	2,390	16,133,270	11,077	11,945
	1902	4	2,179,553	682,643	682,643	....	337,634	9,825	10,107	8,868	1,239	15,626,380	6,139	2,400
NORTH ATLANTIC	1912	159	9,616,877	3,226,157	3,136,497	89,660	2,475,506	77,698	54,031	5,055	48,976	68,625,617	11,704	1,052,379
	1907	150	7,838,995	2,308,082	2,266,506	41,576	1,406,815	56,580	35,325	5,503	29,822	48,861,638	12,320	704,783
	1902	103	3,942,139	1,089,531	1,075,283	14,248	768,353	26,657	17,885	5,559	12,326	28,469,646	7,846	272,212
Under 5,000	1912	107	3,425,265	1,060,570	1,021,488	39,082	779,273	25,661	16,831	963	15,868	18,676,158	2,709	446,864
	1907	107	3,088,388	872,150	845,774	26,376	567,090	24,240	16,103	1,676	14,427	17,742,732	3,546	398,265
	1902	68	1,697,447	392,586	384,109	8,477	294,739	13,967	8,528	1,614	6,914	12,624,636	2,387	151,985
5,000 but under 25,000	1912	43	3,835,433	1,426,777	1,379,337	47,440	1,070,210	32,084	22,508	2,240	20,268	26,971,971	4,202	461,575
	1907	38	3,025,195	897,546	882,346	15,200	571,386	21,049	12,892	2,197	10,695	19,182,675	5,345	255,339
	1902	31	1,510,923	424,886	419,115	5,771	318,692	9,615	6,917	2,117	4,800	10,983,988	3,464	104,902
25,000 and over [3]	1912	9	2,356,179	738,810	735,672	3,138	626,023	19,953	14,692	1,852	12,840	22,977,488	4,793	143,940
	1907	5	1,725,412	538,386	538,386	....	268,339	11,291	6,330	1,630	4,700	11,936,231	3,429	51,179
	1902	4	733,769	272,059	272,059	....	154,922	3,075	2,440	1,828	612	4,861,022	1,995	15,325
SOUTH ATLANTIC	1912	204	7,134,097	2,851,941	2,827,057	24,884	2,045,927	66,845	45,063	1,717	43,346	49,325,343	8,192	853,837
	1907	158	4,076,042	1,621,309	1,574,043	47,266	1,051,602	36,542	22,759	3,620	19,139	30,300,397	7,529	403,016
	1902	75	1,561,938	583,162	577,479	5,683	385,412	12,410	8,469	2,843	5,626	17,072,971	4,230	107,764
Under 5,000	1912	168	3,626,102	1,351,844	1,341,649	10,195	1,008,405	29,945	19,934	994	18,940	19,220,900	2,621	457,360
	1907	142	2,973,002	1,072,023	1,027,220	44,803	726,425	25,119	17,349	1,775	15,574	18,283,131	4,650	294,683
	1902	62	920,726	333,335	328,776	4,559	240,438	8,070	5,215	1,372	3,843	10,349,782	2,010	68,843
5,000 but under 25,000[4]	1912	33	1,512,941	847,744	833,055	14,689	496,823	18,600	12,359	403	11,956	13,197,804	3,003	233,555
	1907	13	476,510	230,343	227,880	2,463	137,415	4,950	3,183	568	2,615	4,563,870	1,715	43,903
	1902	13	641,212	249,827	248,703	1,124	144,974	4,340	3,254	1,471	1,783	6,723,189	2,220	38,921
25,000 and over [5]	1912	3	1,995,054	652,353	652,353	....	540,699	18,300	12,770	320	12,450	16,906,639	2,568	162,922
	1907	3	626,530	318,943	318,943	....	187,762	6,473	2,227	1,277	950	7,453,396	1,164	64,430

[1] See page 25 for states composing the several geographic divisions.

[2] Exclusive of interest on bonds, etc.

[3] Includes, in 1912, 1 station of the "500,000 and over" group; in 1907, 1 station of the "100,000 but under 500,000" group and 1 station of the "500,000 and over" group; and in 1902, 2 stations of the "100,000 but under 500,000" group; in order that the operations of individual stations may not be disclosed.

[4] Includes 2 stations of the "25,000 but under 100,000" group in 1902.

[5] Includes, in 1912, 1 station of the "100,000 but under 500,000" group; and in 1907, 1 station of the "500,000 and over" group.

MUNICIPAL CENTRAL ELECTRIC STATIONS, BY POPULATION OF CITIES IN WHICH LOCATED AND BY GEOGRAPHIC DIVISIONS: 1912, 1907, AND 1902—Continued.

Table 10—Continued.				INCOME.					KILOWATT CAPACITY OF DYNAMOS.				ESTIMATED NUMBER OF LAMPS WIRED FOR SERVICE.	
DIVISION[1] AND POPULATION GROUP.	Census.	Number of stations.	Cost of construction and equipment.	Total.	Electric service.	All other sources.	Total expenses.	Total primary horsepower.	Total.	Direct current, constant voltage and amperage.	Alternating and polyphase current.	Output of stations, kilowatt hours.	Arc.	Incandescent and all other varieties.
NORTH CENTRAL	1912	873	$42,212,002	$11,656,482	$11,314,999	$341,483	$8,589,329	265,159	176,380	33,419	142,961	309,367,765	59,620	3,625,088
	1907	727	22,955,162	7,403,015	7,142,752	260,263	5,072,384	176,221	115,990	32,717	83,273	159,005,189	52,327	2,207,744
	1902	528	13,872,245	4,397,509	4,308,879	88,630	2,938,805	102,895	73,169	33,282	39,887	127,865,521	33,595	1,014,120
Under 5,000	1912	762	16,625,643	6,099,894	5,872,939	226,955	4,695,449	141,037	96,263	20,584	75,679	107,842,471	14,668	2,303,517
	1907	636	11,306,559	4,178,706	3,992,505	186,201	2,999,451	110,320	73,973	20,864	53,109	81,262,275	18,351	1,628,268
	1902	449	7,151,667	2,396,828	2,338,038	58,790	1,736,342	62,994	42,472	15,034	27,438	68,683,634	13,314	770,658
5,000 but under 25,000.	1912	86	7,849,799	2,727,047	2,652,500	74,547	1,836,670	58,042	43,628	3,466	40,162	64,838,060	10,657	1,005,320
	1907	76	4,828,705	1,829,198	1,775,195	54,003	1,127,782	40,166	26,042	4,383	21,659	43,628,086	13,544	522,346
	1902	67	3,145,901	1,009,166	992,917	16,249	658,289	24,123	16,843	6,981	9,862	35,277,472	9,699	226,772
25,000 but under 100,000.	1912	15	2,445,701	736,946	715,438	21,508	503,821	19,545	13,505	890	12,615	20,359,104	6,625	145,395
	1907	6	665,888	200,438	200,123	315	136,986	3,875	2,735	1,380	1,355	5,521,786	2,755	16,572
	1902	4	302,811	87,817	87,762	55	61,575	1,778	989	765	224	2,545,510	1,349	1,100
100,000 but under 500,000.	1912	3	2,976,238	447,667	443,983	3,684	411,328	14,575	10,054	654	9,400	21,534,962	8,919	45,606
	1907	5	2,177,490	472,801	453,057	19,744	260,168	9,720	6,037	1,277	4,760	13,487,582	6,801	32,943
	1902	4	1,092,313	221,055	207,519	13,536	144,965	4,175	2,758	1,633	1,125	5,732,525	3,094	13,190
500,000 and over	1912	7	12,314,621	1,644,928	1,630,139	14,789	1,142,061	31,960	12,930	7,825	5,105	94,793,168	8,751	125,250
	1907	4	3,976,520	721,872	721,872	....	547,997	12,140	7,203	4,813	2,390	15,105,460	10,876	7,615
	1902	4	2,179,553	682,643	682,643	....	337,634	9,825	10,107	8,869	1,238	15,626,380	16,139	2,400
SOUTH CENTRAL	1912	250	8,256,749	2,870,011	2,831,077	38,934	2,080,541	67,576	44,645	4,146	40,499	54,562,006	7,898	653,383
	1907	166	4,259,121	1,640,608	1,609,032	31,576	1,070,069	36,440	25,133	3,840	21,293	34,365,978	7,188	353,833
	1902	81	1,582,386	566,146	554,208	11,938	403,246	14,548	10,393	2,764	7,629	17,484,135	3,640	108,521
Under 5,000	1912	223	5,364,162	1,740,004	1,706,105	33,899	1,392,422	44,271	29,784	3,035	26,749	28,687,220	2,518	442,890
	1907	152	3,046,244	1,133,925	1,104,549	29,376	788,196	27,510	18,415	2,772	15,643	23,272,368	3,578	286,321
	1902	68	929,481	364,251	354,350	9,901	261,938	8,908	5,862	1,485	4,377	10,517,220	1,552	78,623
5,000 but under 25,000.	1912	21	1,513,443	606,193	601,158	5,035	437,880	14,010	9,536	921	8,615	15,395,262	1,899	164,153
	1907	10	705,552	321,549	319,349	2,200	182,060	5,625	3,815	515	3,300	6,861,650	1,680	63,388
	1902	9	364,730	142,742	140,705	2,037	103,559	3,320	2,783	694	2,089	5,233,720	1,054	27,365
25,000 and over[2]	1912	6	1,379,144	523,814	523,814	....	250,239	9,295	5,325	190	5,135	10,479,524	3,481	46,340
	1907	4	507,325	185,134	185,134	....	99,813	3,305	2,903	553	2,350	4,231,960	1,930	4,124
	1902	4	288,175	59,153	59,153	....	37,749	2,320	1,748	585	1,163	1,733,195	1,034	2,533
WESTERN	1912	76	9,845,419	2,614,398	2,554,078	60,320	1,725,862	82,050	48,558	227	48,331	55,645,999	4,437	873,162
	1907	51	3,750,127	1,038,985	1,022,101	16,884	566,318	15,568	9,809	313	9,496	16,929,586	3,576	391,942
	1902	28	1,061,765	328,757	321,007	7,750	245,366	3,518	3,464	1,279	2,185	5,012,166	1,484	74,834
Under 5,000	1912	67	2,308,634	774,267	736,599	37,668	537,444	16,470	9,893	227	9,666	11,867,929	553	245,072
	1907	44	1,062,474	375,038	367,212	7,826	216,957	6,983	4,334	268	4,066	6,345,853	763	114,982
	1902	24	374,687	134,023	133,195	828	86,710	2,343	2,573	1,174	1,399	3,343,021	348	24,837
5,000 and over[3]	1912	9	7,536,785	1,840,131	1,817,479	22,652	1,188,418	65,580	38,665	....	38,665	43,778,070	3,884	628,090
	1907	7	2,687,653	663,947	654,889	9,058	349,361	8,585	5,475	45	5,430	10,583,733	2,813	276,960
	1902	4	687,078	194,734	187,812	6,922	158,656	1,175	891	105	786	1,669,145	1,136	49,997

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[1] See page 25 for states composing the several geographic divisions.

[2] Includes 2 stations of the "100,000 but under 500,000" group in 1912.

[3] Includes, in 1912, 2 stations of the "25,000 but under 100,000" group and 1 station of the "100,000 but under 500,000" group; in 1907, 2 stations of the "25,000 but under 100,000" group; and in 1902, 1 station of the "25,000 but under 100,000" group.

In 1912 the municipal stations in cities of less than 5,000 population reported 47.5 per cent of the total income, 46 per cent of the primary power, 46.8 per cent of the total kilowatt capacity of dynamos, 34.7 per cent of the output of stations, 25.1 per cent of the arc lamps, and 55.2 per cent of the incandescent lamps. These proportions are all considerably less than the corresponding percentages for 1907 and 1902. For most of these items there are decreasing proportions for the several population groups in the order of their arrangement in Table 10. Of the five geographic divisions, the totals for the North Central are by far the largest. This division contained 873 of the municipal stations, or 55.9 per cent of the total number reported for that year; and the income of the stations in this division from the sale of electricity and other sources formed 50.2 per cent of the total income in 1912 and 63.1 per cent in 1902. The power of the prime movers reported by the stations in this division formed 47.4 per cent and 64.3 per cent, respectively, of the primary power reported for 1912 and 1902, 47.8 per cent and 64.5 per cent of the dynamo capacity, 57.6 per cent and 65.3 per cent of the kilowatt-hour output, 64.9 and 66.1 per cent of the number of arc lamps, and 51.4 and 64.3 per cent of the number of incandescent lamps. In every case the proportion reported by the municipal stations in the North Central division was less in 1912 than in 1902. This decreased proportion is largely accounted for by the increased percentages for the South Central and Western divisions.

Purely electric and composite stations.—As stated in the introduction, central electric stations have been classified as purely electric and composite. The purely electric stations embrace those operated entirely as electrical enterprises, and the composite those operated in connection with other industries or services.

Table 11 (p. 26) presents a comparative summary of these two classes of stations for 1912, 1907, and 1902.

Although for all the items shown in Table 11, except the number of steam engines in 1912, the purely electric stations reported more than one-half of the total for the two classes combined, both in 1912 and 1902, the proportions for these stations decreased materially during the decade. A comparison of the totals for the two classes of stations as reported at the censuses of 1902 and 1912 indicates a decided increase in the importance of the composite stations. During the decade 1902 to 1912 the total income for the purely electric stations increased $100,582,448, or 171.6 per cent, and that for the composite stations $115,832,546, or 427.5 per cent. Considering the two classes of stations in the same order and for the same period, the increase in expenses was $75,850,757, or 163.8 per cent, and $90,487,346, or 415.7 per cent; in primary power, 2,760,161 horsepower, or 222.2 per cent, and 2,937,893 horsepower, or 499.4 per cent; in capacity of the dynamos, 2,016,373 kilowatts, or 246.3 per cent, and 1,906,081 kilowatts, or 484.5 per cent; in output of stations, 4,765,446,680 kilowatt hours, or 259.5 per cent, and 4,260,465,211 kilowatt hours, or 635.6 per cent; in number of arc lamps, 6,224, or 2.5 per cent, and 113,473, or 85.1 per cent; and in number of incandescent lamps, 26,117,551, or 213.2 per cent, and 32,195,547, or 541.5 per cent. In every instance the percentages of increase for these totals were greater for the composite stations.

That the purely electric stations lost ground during the decade is further emphasized by the decreases in the percentages of the several totals reported for these stations in 1902 and 1912, respectively, as follows: The income, from 68.4 per cent to 52.7 per cent; the expenses, from 68 per cent to 52.1 per cent; the horsepower, from 67.9 per cent to 53.2 per cent; the kilowatt capacity of dynamos, from 67.5 per cent to 55.2 per cent; the output of stations, kilowatt hours, from 73.3 per cent to 57.2 per cent; the number of arc lamps, from 65.4 per cent to 51.2 per cent; and the number of incandescent lamps, from 67.3 per cent to 50.1 per cent.

In a number of the tables in this report the statistics are presented by geographic divisions. In most of the tables the states are grouped into nine grand divisions, but in a few of the tables it was necessary to present the totals by the five divisions used in 1907 in order that the figures might be comparable with those for prior censuses.

From Map 1 (p. 27) and the following list of states, by geographic divisions, the states in each division can readily be determined, whether the division grouping be that adopted for 1912 or that used in 1907.

NORTH ATLANTIC DIVISION.

New England:
- Maine.
- New Hampshire.
- Vermont.
- Massachusetts.
- Rhode Island.
- Connecticut.

Middle Atlantic:
- New York.
- New Jersey.
- Pennsylvania.

SOUTH ATLANTIC DIVISION.

- Delaware.
- Maryland.
- Dist. Columbia.
- Virginia.
- West Virginia.
- North Carolina.
- South Carolina.
- Georgia.
- Florida.

NORTH CENTRAL DIVISION.

East North Central:
- Ohio.
- Indiana.
- Illinois.
- Michigan.
- Wisconsin.

West North Central:
- Minnesota.
- Iowa.
- Missouri.
- North Dakota.
- South Dakota.
- Nebraska.
- Kansas.

SOUTH CENTRAL DIVISION.

East South Central:
- Kentucky.
- Tennessee.
- Alabama.
- Mississippi.

SOUTH CENTRAL DIVISION—contd.

West South Central:
- Arkansas.
- Louisiana.
- Oklahoma.
- Texas.

WESTERN DIVISION.

Mountain:
- Montana.
- Idaho.
- Wyoming.
- Colorado.
- New Mexico.
- Arizona.
- Utah.
- Nevada.

Pacific:
- Washington.
- Oregon.
- California.

PURELY ELECTRIC AND COMPOSITE CENTRAL ELECTRIC STATIONS—COMMERCIAL AND MUNICIPAL: 1912, 1907, AND 1902.

Table 11	Census.	Aggregate.	PURELY ELECTRIC STATIONS.			COMPOSITE STATIONS.		
			Total.	Commercial.	Municipal.	Total.	Commercial.	Municipal.
Number of stations	1912	5,221	2,772	2,209	563	2,449	1,450	999
	1907	4,714	2,648	2,127	521	2,066	1,335	731
	1902	3,620	2,139	1,759	380	1,481	1,046	435
Per cent of increase, 1902–1912		44.2	29.6	25.6	48.2	65.4	38.6	129.7
Cost of construction and equipment	1912	$2,175,678,266	$1,128,330,859	$1,105,111,379	$23,219,480	$1,047,347,407	$993,501,743	$53,845,664
	1907	$1,096,913,622	$662,926,914	$639,437,274	$23,489,640	$433,986,708	$414,596,901	$19,389,807
	1902	$504,740,352	$334,151,724	$320,580,333	$13,571,391	$170,588,628	$162,139,546	$8,449,082
Per cent of increase, 1902–1912		331.0	237.7	244.7	71.1	514.0	512.7	537.3
Total income	1912	$302,115,599	$159,185,854	$151,515,738	$7,670,116	$142,929,745	$127,380,872	$15,548,873
	1907	$175,642,338	$107.974,921	$101,222,267	$6,752,654	$67,667,417	$60,408,072	$7,259,345
	1902	$85,700,605	$58,603,406	$54,455,737	$4,147,669	$27,097,199	$24,279,763	$2,817,436
Per cent of increase, 1902–1912		252.5	171.6	178.2	84.9	427.5	424.6	451.9
Light, heat, and power	1912	$286,980,858	$152,593,215	$145,118,667	$7,474,548	$134,387,643	$119,198,483	$15,189,160
	1907	$169,614,691	$104,629,574	$98,056,838	$6,572,736	$64,985,117	$57,943,419	$7,041,698
	1902	$84,186,605	$57,470,597	$53,394,158	$4,076,439	$26,716,008	$23,955,591	$2,760,417
Per cent of increase, 1902–1912		240.9	165.5	171.8	83.4	403.0	397.6	450.2
All other sources	1912	$15,134,741	$6,592,639	$6,397,071	$195,568	$8,542,102	$8,182,389	$359,713
	1907	$6,027,647	$3,345,347	$3,165,429	$179,918	$2,682,300	$2,464,653	$217,647
	1902	$1,514,000	$1,132,809	$1,061,579	$71,230	$381,191	$324,172	$57,019
Per cent of increase, 1902–1912		899.7	482.0	502.6	174.6	2,140.9	2,424.1	530.9
Total expenses, including salaries and wages	1912	$234,419,478	$122,164,546	$116,416,962	$5,747,584	$112,254,932	$101,085,351	$11,169,581
	1907	$134,196,911	$76,238,037	$71,411,336	$4,826,701	$57,958,874	$52,468,955	$5,489,919
	1902	$68,081,375	$46,313,789	$43,292,764	$3,021,025	$21,767,586	$19,542,624	$2,224,962
Per cent of increase, 1902–1912		244.3	163.8	168.9	90.3	415.7	417.3	402.0
Total number of persons employed	1912	79,335	40,117	37,635	2,482	39,218	33,760	5,458
	1907	47,632	27,524	24,968	2,556	20,108	17,098	3,010
	1902	30,326	19,609	17,741	1,868	10,717	9,168	1,549
Per cent of increase, 1902–1912		161.6	104.6	112.1	32.9	265.9	268.2	252.4
Total horsepower	1912	7,528,648	4,002,523	3,828,169	174,354	3,526,125	3,141,151	384,974
	1907	4,098,188	2,473,311	2,324,293	149,018	1,624,877	1,452,544	172,333
	1902	[1] 1,830,594	1,242,362	1,151,520	90,842	588,232	519,881	68,351
Per cent of increase, 1902–1912		311.3	222.2	232.4	91.9	499.4	504.2	463.2
Steam engines and steam turbines:[2]								
Number	1912	7,844	3,379	2,767	612	4,465	3,053	1,412
	1907	8,054	4,169	3,467	702	3,885	2,801	1,084
	1902	5,930	3,572	3,053	519	2,358	1,817	541
Per cent of increase,[3] 1902–1912		32.3	−5.4	−9.4	17.9	89.4	68.0	161.0
Horsepower	1912	4,946,532	2,486,304	2,347,253	139,051	2,460,228	2,192,613	267,615
	1907	2,693,273	1,583,978	1,459,569	124,409	1,109,295	948,782	160,513
	1902	1,379,941	891,139	809,249	81,890	488,802	423,674	65,128
Per cent of increase, 1902–1912		258.5	179.0	190.1	69.8	403.3	417.5	310.9
Water wheels:								
Number	1912	2,933	1,657	1,548	109	1,276	1,116	160
	1907	2,481	1,575	1,491	84	906	837	69
	1902	1,390	957	896	61	433	412	21
Per cent of increase, 1902–1912		111.0	73.1	72.8	78.7	194.7	170.9	661.9
Horsepower	1912	2,471,081	1,454,976	1,429,148	25,828	1,016,105	911,672	104,433
	1907	1,349,087	863,885	842,072	21,813	485,202	476,668	8,534
	1902	438,472	344,827	336,029	8,798	93,645	91,225	2,420
Per cent of increase, 1902–1912		463.6	321.9	325.3	193.6	985.1	899.4	4,215.4
Gas and oil engines:								
Number	1912	1,116	667	555	112	449	278	171
	1907	463	295	262	33	168	123	45
	1902	165	86	83	3	79	64	15
Per cent of increase, 1902–1912		576.4	675.6	568.7	3,633.3	468.4	334.4	1,040.0
Horsepower	1912	111,035	61,243	51,768	9,475	49,792	36,866	12,926
	1907	55,828	25,448	22,652	2,796	30,380	27,094	3,286
	1902	12,181	6,396	6,242	154	5,785	4,982	803
Per cent of increase, 1902–1912		811.5	857.5	729.3	6,052.6	760.7	640.0	1,509.7
Kilowatt capacity of dynamos	1912	5,134,689	2,835,178	2,714,920	120,258	2,299,511	2,051,092	248,419
	1907	2,709,225	1,670,814	1,574,286	96,528	1,038,411	925,923	112,488
	1902	1,212,235	818,805	753,021	65,784	393,430	345,834	47,596
Per cent of increase, 1902–1912		323.6	246.3	260.5	82.8	484.5	493.1	421.9
Output of stations, kilowatt hours	1912	11,532,963,006	6,602,195,516	6,443,664,607	158,530,909	4,930,767,490	4,551,771,669	378,995,821
	1907	5,862,276,737	3,880,087,887	3,734,978,340	145,109,547	1,982,188,850	1,837,835,609	144,353,241
	1902	2,507,051,115	1,836,748,836	1,716,909,602	119,839,234	670,302,279	594,237,074	76,065,205
Per cent of increase, 1902–1912		360.0	259.5	275.3	32.3	635.6	666.0	398.3
Estimated number of lamps wired for service:								
Arc	1912	505,395	258,631	223,865	34,766	246,764	189,679	57,085
	1907	555,713	334,286	286,080	48,206	221,427	186,693	34,734
	1902	385,698	252,407	219,409	32,998	133,291	115,494	17,797
Per cent of increase, 1902–1912		31.0	2.5	2.0	5.4	85.1	64.2	220.8
Incandescent and other varieties	1912	76,507,142	38,366,469	35,871,656	2,494,813	38,140,673	33,577,637	4,563,036
	1907	41,608,335	24,449,473	22,733,334	1,716,139	17,158,862	14,813,683	2,345,179
	1902	18,194,044	12,248,918	11,463,050	785,868	5,945,126	5,153,543	791,583
Per cent of increase, 1902–1912		320.5	213.2	212.9	217.5	541.5	551.5	476.4
Stationary motors served:								
Number	1912	435,473	241,209	233,311	7,898	194,264	180,267	13,997
	1907	167,184	97,758	95,472	2,286	69,426	67,205	2,221
	1902	101,064	(4)	(4)	(4)	(4)	(4)	(4)
Per cent of increase, 1902–1912		330.8						
Horsepower capacity	1912	4,130,619	2,311,509	2,258,131	53,378	1,819,110	1,708,197	110,913
	1907	1,649,026	1,077,484	1,061,190	16,294	571,542	556,147	15,395
	1902	438,005	(4)	(4)	(4)	(4)	(4)	(4)
Per cent of increase, 1902–1912		843.1						

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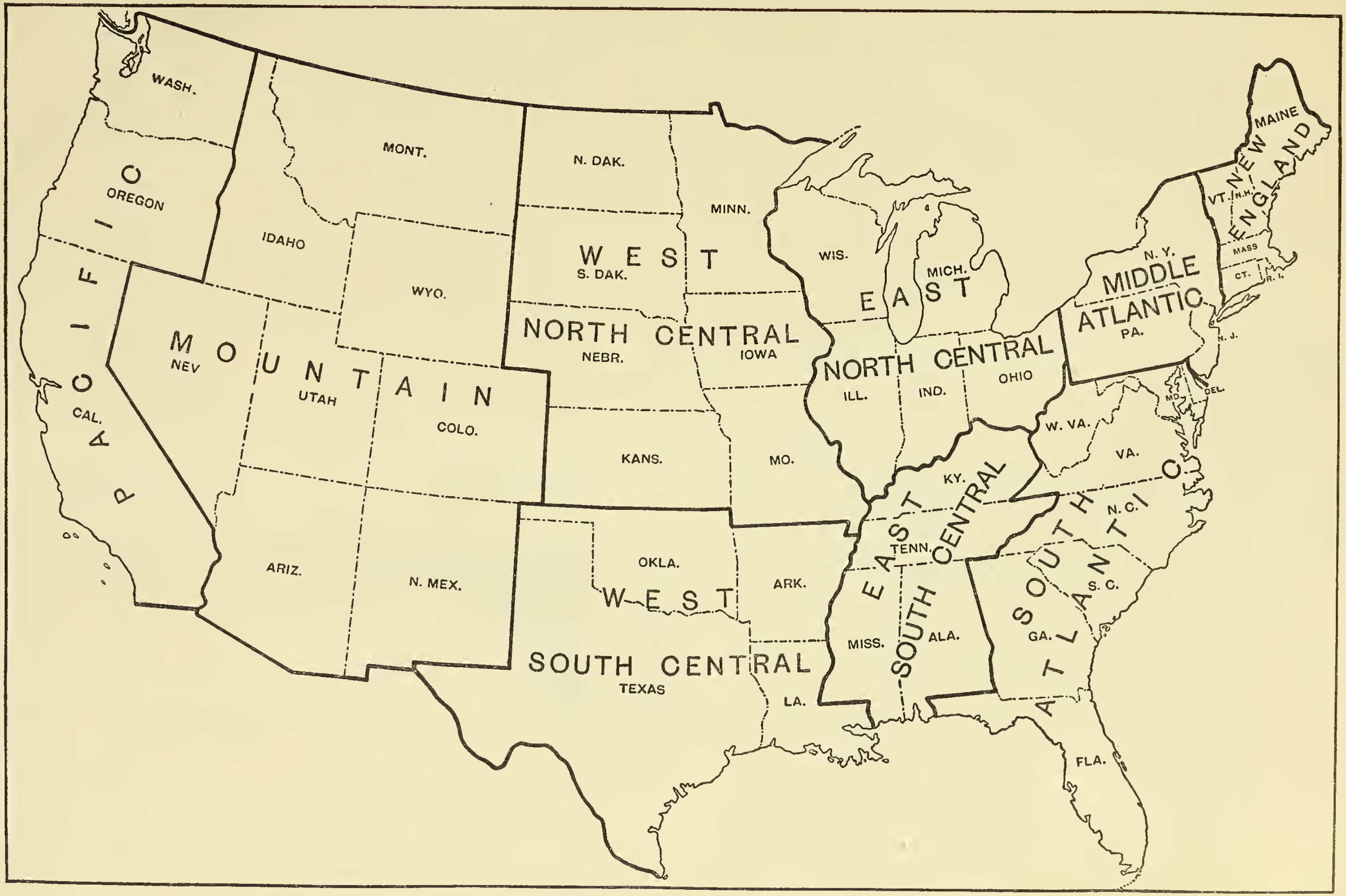
[1] Exclusive of auxiliary engines with a total capacity of 14,454 horsepower.
[2] Includes auxiliary engines in 1912 and 1907.
[3] A minus sign (—) denotes decrease.
[4] Figures not available.

Map 1.—GEOGRAPHIC DIVISIONS AS DEFINED BY THE BUREAU OF THE CENSUS.


PACIFIC
WASH.
OREGON
CAL.
MOUNTAIN
MONT.
IDAHO
WYO.
NEV
UTAH
COLO.
ARIZ.
N. MEX.
WEST NORTH CENTRAL
N. DAK.
MINN.
S. DAK.
NEBR.
IOWA
KANS.
MO.
WEST SOUTH CENTRAL
OKLA.
ARK.
TEXAS
LA.
EAST NORTH CENTRAL
WIS.
MICH.
ILL.
IND.
OHIO
EAST SOUTH CENTRAL
KY.
TENN.
MISS.
ALA.
SOUTH ATLANTIC
W. VA.
VA.
MD.
DEL.
N. C.
S. C.
GA.
FLA.
MIDDLE ATLANTIC
N. Y.
PA.
N. J.
NEW ENGLAND
MAINE
VT.
N.H.
MASS
CT.
R. I.

CHAPTER III.

PRIMARY POWER EQUIPMENT.

Kind of power included.—The primary power equipment as reported for census purposes in 1912 includes steam engines, steam turbines, gas and oil engines, and water wheels. The number and capacity of each of these four kinds of machines were reported separately. Practically the same information was reported for 1907 and 1902, except that steam turbines, which were shown separately in 1907 and 1912, were included with steam engines in 1902, and auxiliary engines, that were shown separately in 1902 and 1907, were not reported separately in 1912. The enlargement of the primary power equipment of existing stations, the construction of new stations of large horsepower capacity, and the installation of generating and consuming appliances of higher efficiency and economy, together with the extension of transmission lines, no doubt have caused the abandonment of the generating equipment of many small stations. This is apparent from the fact that the number of stations which reported no generating equipment in 1912 was 507, or 9.7 per cent of the 5,221 stations reporting, while in 1907, of the 4,714 stations reporting, there were but 227, or 4.8 per cent, which reported no generating equipment.

During the five years from 1907 to 1912 there was a great change in the character of the primary power equipment of electric stations. The steam turbine has largely supplanted the reciprocating engine, particularly in the larger stations.

Table 12 gives comparative data relating to the number and horsepower of the various kinds of primary power machines installed in central electric stations and electric railway plants for 1912, 1907, and 1902.

CENTRAL ELECTRIC STATIONS AND ELECTRIC RAILWAYS—NUMBER, KIND, AND HORSEPOWER OF PRIMARY POWER MACHINES: 1912, 1907, AND 1902.

Table 12	TOTAL.		KIND OF POWER.									
			Total steam.[1]		Steam engines.		Steam turbines.		Gas and oil engines.		Water wheels and turbines.	
	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.
Total:												
1912	14,588	11,193,699	10,108	8,116,086	8,611	3,598,830	1,497	4,517,256	1,164	135,225	3,316	2,942,388
1907	14,635	6,618,011	11,422	5,104,800	10,793	3,751,986	629	1,352,814	504	72,163	2,709	1,441,048
1902	10,661	3,204,333	8,932	2,702,602	8,932	2,702,602	(2)	(2)	180	14,106	1,549	487,625
Central stations:												
1912	11,893	7,528,648	7,844	4,946,532	6,809	1,892,076	1,035	3,054,456	1,116	111,035	2,933	2,471,081
1907	10,998	4,098,188	8,054	2,693,273	7,677	1,875,863	377	817,410	463	55,828	2,481	1,349,087
1902	7,850	1,845,048	6,295	1,394,395	6,295	1,394,395	(2)	(2)	165	12,181	1,390	438,472
Electric railways:												
1912	2,695	3,665,051	2,264	3,169,554	1,802	1,706,754	462	1,462,800	48	24,190	383	471,307
1907	3,637	2,519,823	3,368	2,411,527	3,116	1,876,123	252	535,404	41	16,335	228	91,961
1902	2,811	1,359,285	2,637	1,308,207	2,637	1,308,207	(2)	(2)	15	1,925	159	49,153
	PER CENT OF INCREASE.[3]											
Total:												
1902 to 1912	36.8	249.3	13.2	200.3	−3.6	33.2	....	....	546.7	858.6	114.1	503.4
1907 to 1912	−0.3	69.4	−11.5	59.0	−20.2	−4.1	138.0	233.9	131.0	87.4	22.4	104.2
1902 to 1907	37.3	106.5	27.9	88.9	20.8	38.8	....	....	180.0	411.6	74.9	195.5
Central stations:												
1902 to 1912	51.5	308.0	24.6	254.7	8.2	35.7	....	....	576.4	811.5	111.0	463.6
1907 to 1912	8.1	83.7	−2.6	83.7	−11.3	0.9	174.5	273.7	141.0	98.9	18.2	83.2
1902 to 1907	40.1	122.1	27.9	93.1	22.0	34.5	....	....	180.6	358.3	78.5	207.7
Electric railways:												
1902 to 1912	−4.1	169.6	−14.1	143.3	−31.7	30.5	....	....	220.0	1,156.6	140.9	858.9
1907 to 1912	−25.9	45.4	−32.8	32.4	−42.2	−9.0	83.3	173.2	17.1	48.1	68.0	412.5
1902 to 1907	29.4	85.4	27.7	84.3	18.2	43.4	....	....	173.3	748.6	43.4	87.1

[1] Includes auxiliary engines.

[2] In 1902 steam turbines were included with steam engines.

[3] A minus sign (−) denotes decrease.

The total horsepower capacity of engines in central electric stations and electric railway plants combined was 11,193,699 in 1912, compared with 3,204,333 in 1902, a gain of 7,989,366 horsepower, or 249.3 per cent, during the decade. The central electric stations show the greater gain during this period, reporting an increase of 5,683,600, or 71.1 per cent of the total increase in horsepower.

The total number of engines reported by both branches of the industry increased 3,927, or 36.8 per cent, during the decade. This increase was confined exclusively to the central stations, which increased 4,043 in number, or 51.5 per cent. The number of such machines reported by the street railways, on the other hand, decreased by 116, or 4.1 per cent, during the 10 years.

The increase in the number of engines has not kept pace with that in horsepower, because of the installation of larger units of power. In 1912 the average horsepower capacity per machine was 767, compared with 452 in 1907 and 301 in 1902. The greater increase in the average capacity per machine is shown for electric railway plants. The average horsepower capacity per unit for these stations was 1,360 in 1912, compared with 693 in 1907 and 484 in 1902. In central stations the corresponding average horsepower capacity per unit was 633 in 1912, 373 in 1907, and 235 in 1902.

Diagram 1.—Central Electric Stations and Electric Railways—Primary Power, by Character of Power: 1912.

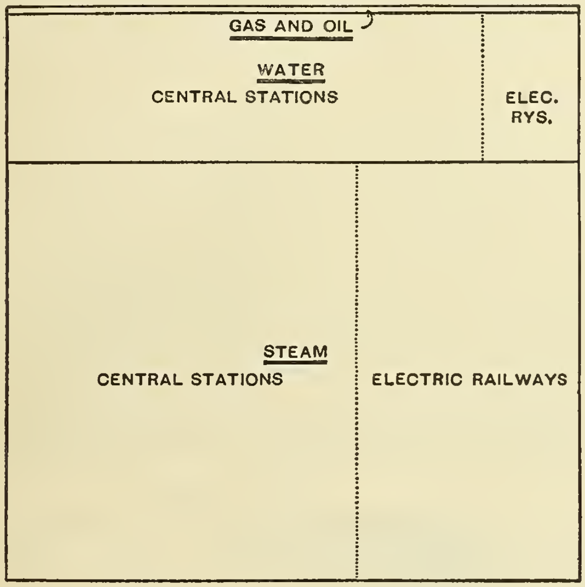
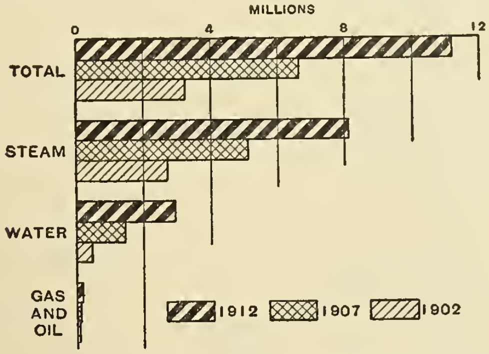


Diagram 2.—Central Electric Stations and Electric Railways—Primary Power, by Character of Power: 1912, 1907, and 1902.



Steam was the most important factor in the development of electrical energy at the three censuses. In the railway plants it formed 86.5 per cent of the total primary power reported in 1912, while in 1907 it represented 95.7 per cent, and in 1902, 96.2 per cent. Steam power held the same relative importance in the central electric stations in 1912 as in 1907, namely, 65.7 per cent, as compared with 75.6 per cent in 1902.

Internal-combustion engines represented 1.2 per cent of the total horsepower in 1912, 1.1 per cent in 1907, and four-tenths of 1 per cent in 1902. The average horsepower per engine was 116 in 1912, 143 in 1907, and 78 in 1902. The central stations reported 82.1 per cent of the total horsepower reported for this class of engines in 1912, 77.4 per cent in 1907, and 86.4 per cent in 1902. They also reported by far the greater number of these engines at each of the three censuses, the proportions being 95.9 per cent in 1912, 91.9 per cent in 1907, and 91.7 per cent in 1902.

Water wheels and water turbines were second in importance in 1912, 1907, and 1902, as to both number and horsepower, increasing 114.1 per cent in number and 503.4 per cent in horsepower during the decade. The corresponding increases between 1907 and 1912 were 22.4 per cent and 104.2 per cent. In 1902 water power represented 15.2 per cent of the total primary horsepower, but in 1907 the proportion had increased to 21.8 per cent and in 1912 to 26.3 per cent. The percentage which water power represented of the total primary horsepower in central electric stations was practically the same in 1912 and 1907, being 32.8 per cent and 32.9 per cent, respectively, while in 1902 it was only 23.8 per cent of the total. Water wheels and water turbines, which represented 3.6 per cent of the total primary horsepower of the electric railway stations in 1902 and 1907, increased to 12.9 per cent in 1912.

Diagram 3.—Central Electric Stations and Electric Railways—Primary Power, by States: 1912.

[States with more than 40,000 horsepower.]

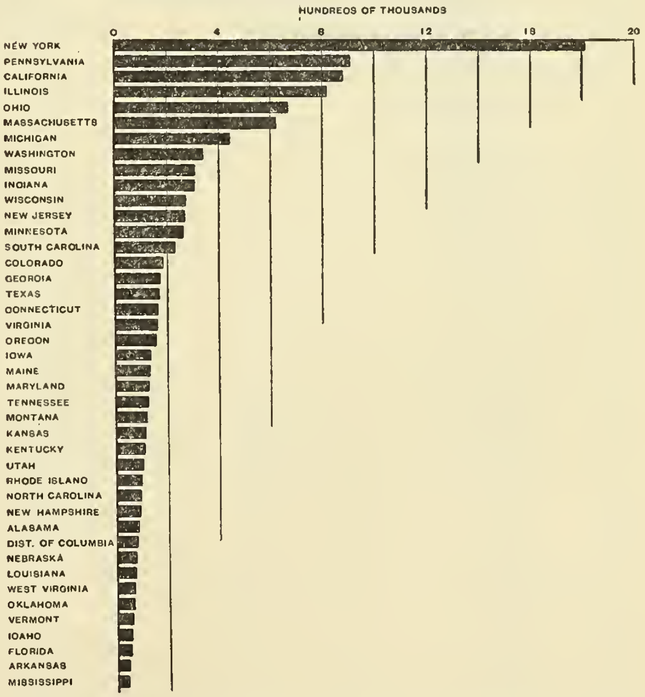


Table 13 gives statistics of the primary power equipment of commercial and municipal stations for 1912, 1907, and 1902.

COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—NUMBER, KIND, AND HORSEPOWER OF PRIMARY POWER MACHINES: 1912, 1907, AND 1902.

Table 13

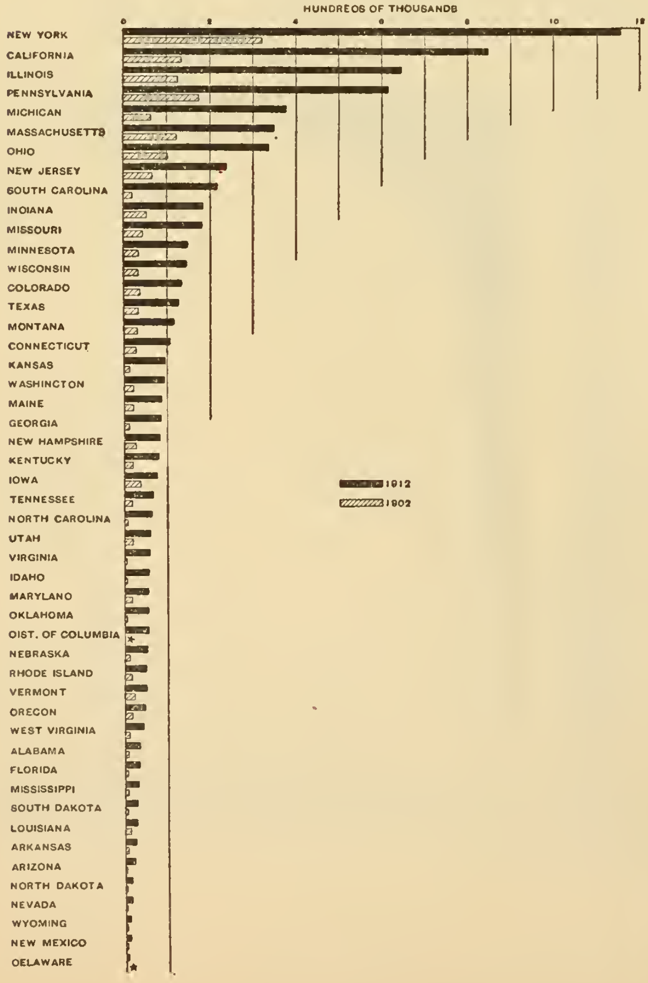
CLASS OF STATIONS.	TOTAL.		KIND OF POWER.									
			Total steam.[1]		Steam engines.		Steam turbines.		Gas and oil engines.		Water wheels and turbines.	
	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.
Total:												
1912	11,893	7,528,648	7,844	4,946,532	6,809	1,892,076	1,035	3,054,456	1,116	111,035	2,933	2,471,081
1907	10,998	4,098,188	8,054	2,693,273	7,677	1,875,863	377	817,410	463	55,828	2,481	1,349,087
1902	7,850	1,845,048	6,295	1,394,395	6,295	1,394,395	(2)	(2)	165	12,181	1,390	438,472
Commercial:												
1912	9,317	6,969,320	5,820	4,539,866	4,898	1,585,583	922	2,954,283	833	88,634	2,664	2,340,820
1907	8,981	3,776,837	6,268	2,408,351	5,920	1,610,326	348	798,025	385	49,746	2,328	1,318,740
1902	6,654	1,685,020	5,199	1,246,542	5,199	1,246,542	(2)	(2)	147	11,224	1,308	427,254
Municipal:												
1912	2,576	559,328	2,024	406,666	1,911	306,493	113	100,173	283	22,401	269	130,261
1907	2,017	321,351	1,786	284,922	1,757	265,537	29	19,385	78	6,082	153	30,347
1902	1,196	160,028	1,096	147,853	1,096	147,853	(2)	(2)	18	957	82	11,218
	PER CENT OF INCREASE.[3]											
Total:												
1902 to 1912	51.5	308.0	24.6	254.7	8.2	35.7	....	....	576.4	811.5	111.0	463.6
1907 to 1912	8.1	83.7	−2.6	83.7	−11.3	0.9	174.5	273.7	141.0	98.9	18.2	83.2
1902 to 1907	40.1	122.1	27.9	93.1	22.0	34.5	....	....	180.6	358.3	78.5	207.7
Commercial:												
1902 to 1912	40.0	313.6	11.9	264.2	−5.8	27.2	....	....	466.7	689.7	103.7	447.9
1907 to 1912	3.7	84.5	−7.1	88.5	−17.3	−1.5	164.9	270.2	116.4	78.2	14.4	77.5
1902 to 1907	35.0	124.1	20.6	93.2	13.9	29.2	....	....	161.9	343.2	78.0	208.7
Municipal:												
1902 to 1912	115.4	249.1	84.7	175.0	74.4	107.3	....	....	1,472.2	2,240.8	228.0	1,061.2
1907 to 1912	27.7	74.1	13.3	42.7	8.8	15.4	289.7	416.8	262.8	268.3	75.8	329.2
1902 to 1907	68.6	100.8	63.0	92.7	60.3	79.6	....	....	333.3	535.5	86.6	170.5

[1] Includes auxiliary engines.

[2] In 1902 steam turbines were included with steam engines.

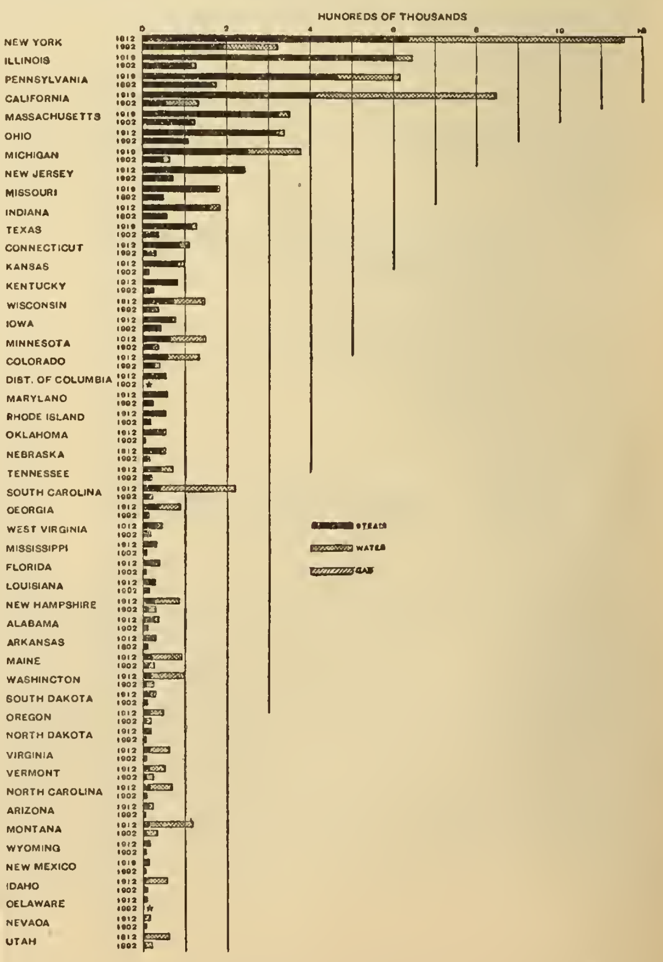
[3] A minus sign (−) denotes decrease.

DIAGRAM 4.—CENTRAL ELECTRIC STATIONS—PRIMARY POWER. BY STATES: 1912 AND 1902.



* DIST. OF COLUMBIA AND DELAWARE COMBINED IN 1902: SEPARATE FIGURES NOT AVAILABLE

DIAGRAM 5.—CENTRAL ELECTRIC STATIONS—PRIMARY POWER—STEAM, WATER, AND GAS—BY STATES, RANKED ACCORDING TO STEAM POWER: 1912 AND 1902.



* DIST. OF COLUMBIA AND DELAWARE COMBINED IN 1902; SEPARATE FIGURES NOT AVAILABLE.

The total horsepower capacity of the primary power machines in central electric stations increased 5,683,600, or 308 per cent, between 1902 and 1912, and of this increase 3,552,137 horsepower, or 62.5 per cent, was contributed by steam power. The great development of the steam turbine in recent years is indicated by the fact that, while there was a gain of 2,253,259 in the horsepower of steam engines and steam turbines combined between 1907 and 1912, the horsepower of steam turbines alone increased during the same period by 2,237,046, or 99.3 per cent of the total increase.

The horsepower increase reported for water wheels and turbines between 1902 and 1912 was 2,032,609, or 463.6 per cent, constituting 35.8 per cent of the total increase for all kinds of primary horsepower during the same period.

Of the two classes of stations, the commercial shows by far the greater amount of horsepower and the larger increase since 1902. In 1912 the primary power equipment of this class represented 92.6 per cent of the total, compared with 92.2 per cent in 1907 and 91.3 per cent in 1902.

Number of different kinds of prime movers.—Although most of the central stations reported but one class of primary power, a number used two or more varieties of prime movers. Table 14 shows the number of commercial and municipal stations reporting each class of machines at the censuses of 1912, 1907, and 1902.

Table 14

COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—DISTRIBUTION BY NUMBER OF STATIONS AND KINDS OF PRIMARY POWER: 1912, 1907, AND 1902.

KIND OF POWER.	Census.	Number of stations.		
		Total.	Commercial.	Municipal.
Steam engines	1912	3,529	2,338	1,191
	1907	3,704	2,606	1,098
	1902	3,100	2,356	744
Steam turbines	1912	454	388	66
	1907	187	170	17
	1902	(1)	(1)	(1)
Gas and oil engines	1912	713	518	195
	1907	294	238	56
	1902	101	86	15
Water wheels and turbines	1912	1,035	915	120
	1907	910	821	89
	1902	580	530	50
Auxiliary engines	1912	(2)	(2)	(2)
	1907	328	282	46
	1902	201	175	26

[1] In 1902 steam turbines were included with steam engines.
[2] Not reported separately.

The total of the number of stations as given in Table 14 exceeds the actual number of central electric stations reported, since a station which had two or more different kinds of primary power would be reported under each class.

Auxiliary engines, which were no doubt included as a part of the primary power equipment of the central stations, were not reported separately for 1912 as they were in 1907 and 1902. These engines are chiefly of the reciprocating class, and those reported in 1907 and 1902 should be included with steam engines for purposes of comparison. A comparison, on this basis, of the stations reporting steam engines shows 3,529 stations in 1912, 4,032 in 1907, and 3,301 in 1902. Of the total number of central stations, the proportion equipped with reciprocating engines was smaller at each succeeding census, as follows: In 1902, 91.2 per cent; in 1907, 85.5 per cent; and in 1912, 67.6 per cent. On the other hand, there was an increase both in number and in percentage for every other type of engine. The percentage of stations with steam turbines was 4 in 1907 and 8.7 in 1912. This type of engine was not reported separately in 1902. The percentage of stations equipped with gas and oil engines increased from 2.8 in 1902 to 6.2 in 1907 and 13.7 in 1912, while for stations reporting water wheels the proportion increased from 16 per cent in 1902 to 19.3 per cent in 1907 and 19.8 per cent in 1912.

In connection with the numbers of the different kinds of machines, it is instructive to consider the size of the average station as determined by the horsepower of the prime movers, and also the average size of the different varieties of machines. Table 15 gives, for the various kinds of primary power machines in commercial and in municipal stations, the average horsepower per station and per machine for 1912, 1907, and 1902.

Table 15

COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—AVERAGE PRIMARY HORSEPOWER PER STATION AND PER MACHINE.

KIND OF POWER.	Total.			Commercial.			Municipal.		
	1912	**1907**	**1902**	**1912**	**1907**	**1902**	**1912**	**1907**	**1902**
Total power:									
Per station	1,442	869	510	1,905	1,091	601	358	257	196
Per machine	633	373	235	748	421	253	217	159	134
Steam engines and steam turbines:									
Per machine	631	365	233	780	427	253	201	165	139
Steam engines—									
Per station	536	489	445	678	593	523	257	240	198
Per machine	278	265	233	324	301	253	160	157	139
Steam turbines—									
Per station	6,728	4,371	(1)	7,614	4,694	(1)	1,518	1,140	(1)
Per machine	2,951	2,168	(1)	3,204	2,293	(1)	886	668	(1)
Gas and oil engines:									
Per station	156	190	121	171	209	131	115	109	64
Per machine	99	121	74	106	129	76	79	78	53
Water wheels and turbines:									
Per station	2,388	1,483	756	2,558	1,606	806	1,086	341	224
Per machine	843	544	315	879	566	327	484	198	137
Auxiliary engines:									
Per station	(2)	201	72	(2)	228	78	(2)	33	32
Per machine	(2)	78	40	(2)	83	41	(2)	21	23

[1] In 1902 steam turbines were included with steam engines.
[2] Not reported separately.

The total average horsepower per station and per machine for each of the various kinds of primary power increased at each census, with the exception that for gas and oil engines there was a decrease in both respects from 1907 to 1912. This decrease is due to the abandonment of several exceptionally large engines of this type that were in use in 1907 on the Pacific coast. The total average horsepower per station for all machines increased by 932, or 182.7 per cent, from 1902 to 1912. The corresponding increase in the average per station for commercial plants during the same period was 1,304 horsepower, or 217 per cent, and for municipal stations 162 horsepower, or 82.7 per cent.

Steam power.—In the statistics given in Table 16, relative to the number and horsepower of steam engines and steam turbines, grouped according to horsepower, for commercial and municipal stations, for 1912, 1907, and 1902, the respective groups are not representative of the entire steam equipment of the stations classified according to horsepower. Stations reporting steam power of the largest units, for instance, often require, in addition, smaller engines for various kinds of work, and this in a measure accounts for the large number of engines in the group of the smallest horsepower.

COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—STEAM ENGINES AND STEAM TURBINES, BY HORSEPOWER CAPACITY: 1912, 1907, AND 1902.

Table 16

CLASS OF STATIONS.	TOTAL.		ENGINES GROUPED ACCORDING TO HORSEPOWER.							
			500 horsepower or under.		Over 500 and under 2,000 horsepower.		2,000 and under 5,000 horsepower.		5,000 horsepower and over.	
	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.
Total:										
1912	7,844	4,946,532	6,329	1,091,370	1,042	978,551	294	845,381	179	2,031,230
1907	7,206	2,627,450	6,248	1,035,583	747	661,746	148	407,695	63	522,426
1902	5,930	1,379,941	5,451	849,336	427	381,055	52	149,550	(1)	(1)
Commercial:										
1912	5,820	4,539,866	4,399	795,351	961	904,288	281	808,997	179	2,031,230
1907	5,492	2,344,032	4,584	794,205	699	625,006	146	402,395	63	522,426
1902	4,870	1,232,923	4,407	715,418	411	367,955	52	149,550	(1)	(1)
Municipal:										
1912	2,024	406,666	1,930	296,019	81	74,263	13	36,384	....	....
1907	1,714	283,418	1,664	241,378	48	36,740	2	5,300	....	....
1902	1,060	147,018	1,044	133,918	16	13,100	....	....	....	....
STEAM ENGINES.										
Total:										
1912	6,809	1,892,076	6,136	1,037,655	565	508,373	92	240,794	16	105,254
1907	6,829	1,810,040	6,183	1,018,566	557	489,694	70	186,280	19	115,500
1902	5,930	1,379,941	5,451	849,336	427	381,055	52	149,550	(1)	(1)
Commercial:										
1912	4,898	1,585,583	4,252	752,702	538	486,833	92	240,794	16	105,254
1907	5,144	1,546,007	4,535	781,673	520	462,554	70	186,280	19	115,500
1902	4,870	1,232,923	4,407	715,418	411	367,955	52	149,550	(1)	(1)
Municipal:										
1912	1,911	306,493	1,884	284,953	27	21,540	....	....	....	....
1907	1,685	264,033	1,648	236,893	37	27,140	....	....	....	....
1902	1,060	147,018	1,044	133,918	16	13,100	....	....	....	....
STEAM TURBINES.[2]										
Total:										
1912	1,035	3,054,456	193	53,715	477	470,178	202	604,587	163	1,925,976
1907	377	817,410	65	17,017	190	172,052	78	221,415	44	406,926
Commercial:										
1912	922	2,954,283	147	42,649	423	417,455	189	568,203	163	1,925,976
1907	348	798,025	49	12,532	179	162,452	76	216,115	44	406,926
Municipal:										
1912	113	100,173	46	11,066	54	52,723	13	36,384	....	....
1907	29	19,385	16	4,485	11	9,600	2	5,300	....	....

[1] Included in "2,000 and under 5,000 horsepower." The class "5,000 horsepower and over" was not called for at the census of 1902.

[2] Steam turbines were included with steam engines in 1902.

Table 17 gives the percentages of increase for the census periods in the several groups shown in Table 16.

The increases that have taken place in the horsepower of the larger types of steam engines are especially noticeable. Between 1902 and 1912 the horsepower of steam engines and steam turbines combined increased by 3,566,591, or 258.5 per cent, and of this horsepower increase 2,727,061 was reported for engines with a capacity of 2,000 horsepower and over. The horsepower reported for the engines of 2,000 horsepower and over formed 58.2 per cent of the total horsepower in 1912, compared with but 10.8 per cent in 1902. In 1912 the total capacity of engines of 5,000 or more horsepower per unit was 2,031,230, or 41.1 per cent of the total, compared with 522,426 horsepower, or 19.9 per cent of the total reported in 1907. The commercial stations reported the most marked gains in the large units of power, showing an increase from 12.1 per cent for the class of 2,000 and over in 1902 to 62.6 per cent in 1912, with a corresponding decrease in the proportion for the engines of less than 2,000 horsepower from 87.9 per cent of the total steam power in 1902 to 37.4 per cent in 1912. Engines of 5,000 horsepower and over were not reported separately in 1902, being included with those of 2,000 horsepower and over. In 1907 and 1912, when this class was shown separately, all such engines were reported by the commercial stations.

Table 17 STEAM ENGINES AND STEAM TURBINES, PER CENT OF INCREASE:[1] (BASED UPON TABLE 16).

CLASS OF STATIONS.	TOTAL.		Engines grouped according to horsepower.							
			500 horsepower or under.		Over 500 and under 2,000 horsepower.		2,000 and under 5,000 horsepower.		5,000 horsepower and over.	
	Number	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.
Total:										
1902-1912	32.3	258.5	16.1	28.5	144.0	156.8	465.4	465.3	(2)	(2)
1907-1912	8.9	88.3	1.3	5.4	39.5	47.9	98.6	107.4	184.1	288.8
1902-1907	21.5	90.4	14.6	21.9	74.9	73.7	184.6	172.6	(2)	(2)
Commercial:										
1902-1912	19.5	268.2	−0.2	11.2	133.8	145.8	440.4	441.0	(2)	(2)
1907-1912	6.0	93.7	−4.0	0.1	37.5	44.7	92.5	101.0	184.1	288.8
1902-1907	12.8	90.1	4.0	11.0	70.1	69.9	180.8	169.1	(2)	(2)
Municipal:										
1902-1912	90.9	176.6	84.9	121.0	406.2	466.9	.....	.....	(2)	(2)
1907-1912	18.1	43.5	16.0	22.6	68.8	102.1	550.0	586.5	.....	.....
1902-1907	61.7	92.8	59.4	80.2	200.0	180.5	.....	.....	(2)	(2)
STEAM ENGINES.										
Total:										
1902-1912	14.8	37.1	12.6	22.2	32.3	33.4	76.9	61.0	(2)	(2)
1907-1912	−0.3	4.5	−0.8	1.9	1.4	3.8	31.4	29.3	−15.8	−8.9
1902-1907	15.2	31.2	13.4	19.9	30.4	28.5	34.6	24.6	(2)	(2)
Commercial:										
1902-1912	0.6	28.6	−3.5	5.2	30.9	32.3	76.9	61.0	(2)	(2)
1907-1912	−4.8	2.6	−6.2	−3.7	3.5	5.2	31.4	29.3	−15.8	−8.9
1902-1907	5.6	25.4	2.9	9.3	26.5	25.7	34.6	24.6	(2)	(2)
Municipal:										
1902-1912	80.3	108.5	80.5	112.8	68.8	64.4	.....	.....	(2)	(2)
1907-1912	13.4	16.1	14.3	20.3	−27.0	−20.6	.....	.....	.....	.....
1902-1907	59.0	79.6	57.9	76.9	131.2	107.2	.....	.....	(2)	(2)
STEAM TURBINES.[3]										
Total:										
1907-1912	174.5	273.7	196.9	215.7	151.1	173.3	159.0	173.1	270.5	373.3
Commercial:										
1907-1912	164.9	270.2	200.0	240.3	136.3	157.0	148.7	162.9	270.5	373.3
Municipal:										
1907-1912	289.7	416.8	187.5	146.7	390.9	449.2	550.0	586.5	.....	.....

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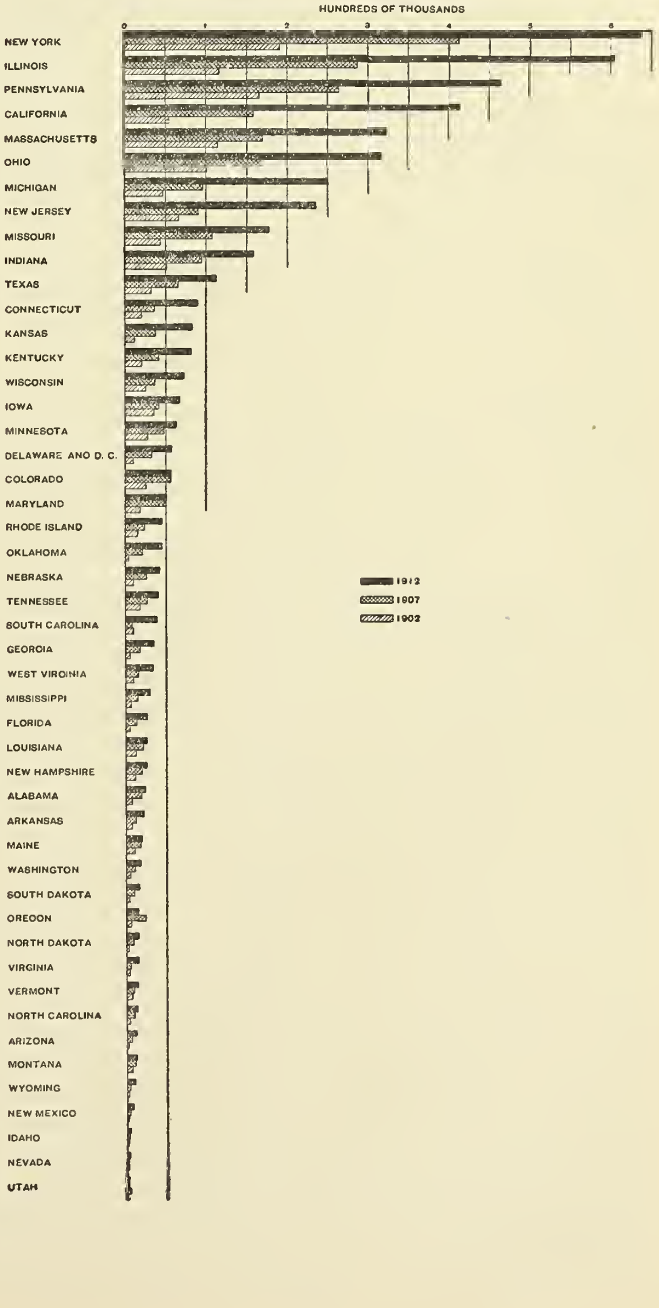
[1] A minus sign (−) denotes decrease.
[2] Included in "2,000 and under 5,000 horsepower." The class "5,000 horsepower and over" was not called for at the census of 1902.
[3] Steam turbines were included with steam engines in 1902.

The steam engine.—The horsepower reported for the reciprocating engines at the several censuses shows the result of the advance in the use of the turbine. Everything else being equal as to economy of operation and maintenance, as well as general efficiency, the matter of space occupied per horsepower is a powerful factor in favor of the turbine. A single illustration will suffice. The area occupied by a turbogenerator of 3,500 kilowatt capacity in one central station is 918 square feet, and it generates approximately eighteen times as much power as the old reciprocating engine per unit of space occupied.

There was a substantial increase in horsepower between 1902 and 1912 for all classes of reciprocating engines in both commercial and municipal stations, but a comparison of the totals for 1907 with those for 1912 furnishes a better index of late conditions in respect to horsepower. In the five years from 1907 to 1912 the total horsepower of the reciprocating engines in commercial and municipal stations combined increased only 82,036, or 4.5 per cent. Those of this class having 500 horsepower and under increased by 19,089 horsepower, or 1.9 per cent; those of over 500 and under 2,000 horsepower increased by 18,679 horsepower, or 3.8 per cent; while those of 2,000 but less than 5,000 horsepower increased by 54,514 horsepower, or 29.3 per cent. The tendency to discontinue the installation of this class of engine where the largest units of power are required is shown by the fact that reciprocating engines with a horsepower capacity of 5,000 or over decreased by 10,246 horsepower, or 8.9 per cent, during the five years.

The commercial stations reported 89.3 per cent of the total horsepower of all classes of reciprocating engines in 1902, 85.4 per cent in 1907, and 83.8 per cent in 1912.

Diagram 6.—Central Electric Stations—Steam Power, by States: 1912, 1907, and 1902.



About nine-tenths of the total number of reciprocating engines in use were of 500 horsepower and under in 1912, 1907, and 1902, for both commercial and municipal stations. In 1912, of the total number of engines of 500 horsepower and under, 69.5 per cent were reported by the commercial stations and 30.5 per cent by the municipal stations.

The steam turbine.—Separate data were not collected for steam turbines at the census of 1902, but they were included in the totals for steam engines. For commercial and municipal stations combined, from 1907 to 1912, the horsepower of the steam turbines increased by 2,237,046, or 273.7 per cent. In 1912 the horsepower of turbines of 500 horsepower and under constituted 1.8 per cent of the total for turbines, compared with 2.1 per cent in 1907. The proportion of those having a capacity of over 500 and under 2,000 horsepower decreased from 21 per cent in 1907 to 15.4 per cent in 1912; the next class, those with a horsepower capacity of 2,000 but less than 5,000, decreased from 27.1 per cent in 1907 to 19.8 per cent in 1912. The proportion for turbines of 5,000 or more horsepower increased from 49.8 per cent in 1907 to 63.1 per cent in 1912. Each of the several classes of turbines, however, shows a considerable actual increase in number and horsepower from 1907 to 1912.

All states, with the exception of Delaware and Utah, reported turbines in 1912. Five states—Illinois, New York, California, Pennsylvania, and Massachusetts—combined reported 56.4 per cent of the total turbine horsepower in 1912 and 58.4 per cent in 1907.

Water power.—One of the most important matters affecting the electrical industries is the use of water as a primary power. The development in electrical appliances for converting water power into electric energy, which by transmission lines is made available over large areas, together with the economy of production, indicates a continued increase in this form of primary power and a probability that it will to a still greater extent take the place of primary power derived by the use of fuel. In connection with the statistics for water power it is proper to state that the totals for 1912 include the report for a company which showed no electrical equipment but simply water power amounting to 156,000 horsepower. A separate report under a different name was made covering the generation of current and other electrical features. In 1907 a single report covered both phases of the industry; therefore the two reports in 1912 were included in order to preserve the comparability of the figures. The operation of several central stations under the same ownership—a characteristic feature of this industry—renders it difficult to present accurate totals of the generating equipment for the individual states. The statistics for stations in one state are in some instances included in the combined report for a company reporting in another state. A notable instance of this character occurs in the statistics for Nevada. A primary power plant and generating station located in California, within a few miles of the Nevada state line, has been credited to Nevada because the current is all distributed and the office of the company is located in the latter state. The map, however (p. 37), shows this plant as located in California, at the source of power.

Diagram 7.—Central Electric Stations—Water Power, by States: 1912, 1907, and 1902.

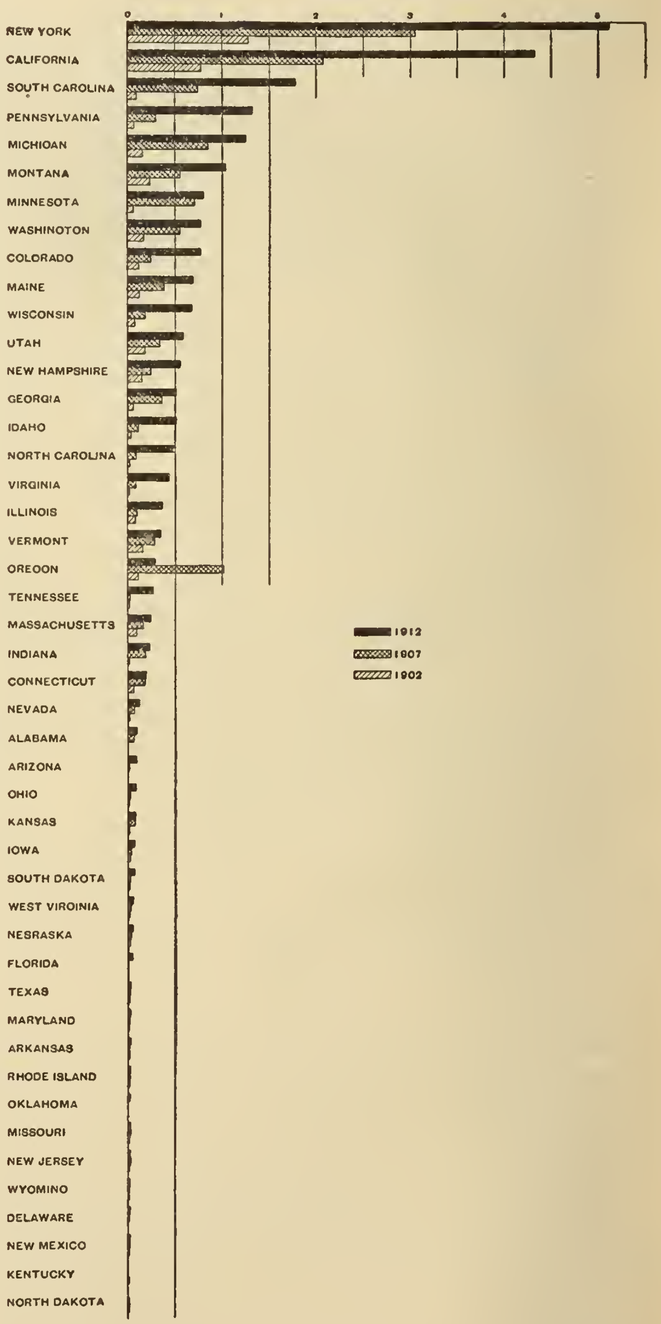


Table 18 gives the number of water wheels and water turbines, grouped by their horsepower capacity, for commercial and municipal stations, for 1912, 1907, and 1902.

The total water power increased 2,032,609 horsepower, or 463.6 per cent, from 1902 to 1912. In 1912 and 1907 water wheels and water turbines contributed approximately one-third of the total primary power of central stations. As in the case of steam power, the greatest increase took place in the large units. Water turbines with a capacity of 5,000 or more horsepower increased by 754,286 or 222 per cent, between 1907 and 1912, this increase forming 67.2 per cent of the total increase in water power for central stations during that period.

COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—WATER WHEELS AND TURBINES, BY NUMBER AND HORSEPOWER CAPACITY: 1912, 1907, AND 1902.

Table 18 CLASS OF STATIONS.	TOTAL.		MACHINES GROUPED ACCORDING TO HORSEPOWER.							
			500 horsepower or under.		Over 500 and under 2,000 horsepower.		2,000 and under 5,000 horsepower.		5,000 horsepower and over.	
	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.
Total:										
1912	2,933	2,471,081	1,995	333,795	638	594,440	147	448,760	153	1,094,086
1907	2,481	1,349,087	1,910	320,636	405	357,671	111	330,980	55	339,800
1902	1,390	438,472	1,192	174,559	166	156,613	32	107,300	(1)	(1)
Commercial:										
1912	2,664	2,340,820	1,797	298,674	576	554,100	144	441,960	147	1,046,086
1907	2,328	1,318,740	1,761	296,689	403	355,671	109	326,580	55	339,800
1902	1,308	427,254	1,112	164,981	164	154,973	32	107,300	(1)	(1)
Municipal:										
1912	269	130,261	198	35,121	62	40,340	3	6,800	6	48,000
1907	153	30,347	149	23,947	2	2,000	2	4,400	....	....
1902	82	11,218	80	9,578	2	1,640	....	....	....	....
	PER CENT OF INCREASE.									
Total:										
1902–1912	111.0	463.6	67.4	91.2	284.3	279.6	359.4	318.2	....	....
1907–1912	18.2	83.2	4.4	4.1	57.5	66.2	32.4	35.6	178.2	222.0
1902–1907	78.5	207.7	60.2	83.7	144.0	128.4	246.9	208.5	....	....
Commercial:										
1902–1912	103.7	447.9	61.6	81.0	251.2	257.5	350.0	311.9	....	....
1907–1912	14.4	77.5	2.0	0.7	42.9	55.8	32.1	35.3	167.3	207.9
1902–1907	78.0	208.7	58.4	79.8	145.7	129.5	240.6	204.4	....	....
Municipal:										
1902–1912	228.0	1,061.2	147.5	266.7	3,000.0	2,359.8	....	....	....	....
1907–1912	75.8	329.2	32.9	46.7	3,000.0	1,917.0	50.0	54.5	....	....
1902–1907	86.6	170.5	86.2	150.0	0.0	22.0	....	....	....	....
	PER CENT DISTRIBUTION.									
Total:										
1912	100.0	100.0	68.0	13.5	21.8	24.1	5.0	18.2	5.2	44.3
1907	100.0	100.0	77.0	23.8	16.3	26.5	4.5	24.5	2.2	25.2
1902	100.0	100.0	85.8	39.8	11.9	35.7	2.3	24.5	(1)	(1)
Commercial:										
1912	100.0	100.0	67.5	12.8	21.6	23.7	5.4	18.9	5.5	44.7
1907	100.0	100.0	75.6	22.5	17.3	27.0	4.7	24.8	2.4	25.8
1902	100.0	100.0	85.0	38.6	12.5	36.3	2.4	25.1	(1)	(1)
Municipal:										
1912	100.0	100.0	73.6	27.0	23.0	31.0	1.2	5.2	2.2	36.8
1907	100.0	100.0	97.4	78.9	1.4	6.6	1.3	14.5	....	....
1902	100.0	100.0	97.6	85.4	2.4	14.6	....	....	....	....

[1] Included in "2,000 and under 5,000 horsepower." The class "5,000 horsepower and over" was not called for at the census of 1902.

At all three censuses the commercial stations reported more than nine-tenths of the total water-power capacity, and in 1912, of the total power of water turbines with a capacity of 2,000 or more horsepower, 96.4 per cent was reported by these stations.

Water power was reported as used for the generating of electricity in every state, with the exception of Kentucky, Louisiana, Mississippi, North Dakota, and the District of Columbia.

The water power reported for New York, California, South Carolina, Pennsylvania, Michigan, and Montana combined was 1,483,280 horsepower, or 60 per cent of the total for the United States. These states contained some of the largest units reported, the number of wheels or turbines reported forming only 39 per cent of the total number. The average horsepower per unit was 843 for the United States, while in California the average was 2,108 horsepower. The six states mentioned were the only states for which 100,000 or more horsepower was reported in 1912 The decrease in Oregon from 102,052 horsepower in 1907 to 29,802 in 1912 is due to the acquirement by electric railway companies since 1907 of some of the large central stations. The statistics for these stations, therefore, are lost to the central station branch of the industry and are included in the report on electric railways for 1912. Combining the statistics for the two industries for the United States brings out the fact that from 1907 to 1912 the capacity of all water wheels increased by 1,501,340 horsepower, or 104.2 per cent.

Hydroelectric stations.—Estimates of the total water-power capacity of the United States, developed and undeveloped, vary widely. Including storage basins, the water-power capacity has been estimated at upward of 200,000,000 horsepower. It is deemed preferable, however, in presenting estimates of the water-power capacity of the United States, to exclude that of storage. In round numbers, the capacity of the streams, exclusive of storage, is estimated at from 27,000,000 minimum horsepower, at times of drouth or low water, to 52,000,000[1] maximum. The practical utility of the excess of power at times when the streams are at high water or swollen by floods seems too uncertain, however, to be used as a fair basis of capacity. Of the two estimates, therefore, it appears safer to accept the minimum, 27,000,000, as representing the dependable water horsepower, exclusive of storage, developed and undeveloped, in the United States.

The development of the water-power resources of the country received a tremendous impetus with the advances made in electrical science. This power formerly was of local utility only, and its application is still in some measure thus restricted. Water power now, however, may be used locally to develop electric current which can be transmitted long distances to cities, towns, and isolated manufacturing plants. The electric current thus becomes available in large or small quantities for use not only as mechanical power, by means of the electric motor, but also for heat and light.

The term "hydroelectric" is generally applied to central stations of considerable magnitude. Water power was reported for 1,035 central stations for 1912, and although a majority of them also reported other power, there were 496 stations in 1912 that reported water power only. Water power once installed is conceded to be the most economical to operate, and it may be assumed, therefore, that when other primary power is added to this equipment it is generally for emergency purposes, such as the failure of the water supply, breakdowns, or repairs.

There were 225 stations for each of which the water power reported for 1912 amounted to 1,000 or more horsepower, and these have been tabulated separately as representing the hydroelectric stations. The map on page 37 shows the location of these stations. Table 19 summarizes the statistics for these stations and places them in comparison with those for all central stations.

The combined water power for the stations outside of what is represented by those of 1,000 or more horsepower amounted to only 182,685 horsepower, or 7.4 per cent of the total water power for all central electric stations in 1912. The 225 hydroelectric stations shown in Table 19 form only 4.3 per cent of the total number of central stations, and yet it will be seen from the table that they reported 42.2 per cent of the aggregate horsepower, 92.6 per cent of the water power, 38 per cent of the dynamo capacity, 50.8 per cent of the kilowatt-hour output, 31.1 per cent of the horsepower of stationary motors, 42.4 per cent of the cost of construction and equipment, and 24.1 per cent of the income.

Table 19

	CENTRAL ELECTRIC STATIONS: 1912.		
	Total.	Stations reporting water power of 1,000 horsepower and over.	
		Number or amount.	Per cent of total.
Number of stations	5,221	225	4.3
Cost of construction and equipment	$2,175,678,266	$922,954,341	42.2
Total income	$302,115,599	$72,717,582	24.1
Light, heat, and power, including free service	$286,980,858	$66,852,631	23.3
All other sources	$15,134,741	$5,864,951	38.8
Total expenses, including salaries and wages	$234,419,478	$56,342,064	24.0
Total number of persons employed	79,335	17,160	21.6
Total horsepower	7,528,648	3,179,244	42.2
Steam engines and steam turbines:			
Number	7,844	520	6.6
Horsepower	4,946,532	885,162	17.9
Water wheels and turbines:			
Number	2,933	1,552	52.9
Horsepower	2,471,081	2,288,396	92.6
Gas and oil engines:			
Number	1,116	19	1.7
Horsepower	111,035	5,686	5.1
Kilowatt capacity of dynamos	5,134,689	1,951,397	38.0
Output of stations, kilowatt hours	11,532,963,006	5,859,397,943	50.8
Estimated number of lamps wired for service:			
Arc	505,395	62,624	12.4
Incandescent and other varieties	76,507,142	13,403,893	17.5
Stationary motors served:			
Number	435,473	73,645	16.9
Horsepower	4,130,619	1,283,769	31.1

There are some companies that operate two or more plants in each of which, or in all combined, the water power exceeded 1,000 horsepower. Each such company included the statistics for all its plants in a single report which was counted as representing one station. For this reason the 225 stations should not be accepted as the number of separate plants of the class indicated.

A considerable part of the business of stations of this character is the sale of electricity in bulk, since of the total number of lamps reported by all central stations those reported by the hydroelectric stations formed but 12.4 per cent of the arcs and 17.5 per cent of the incandescents. Again, while the hydroelectric stations reported 23.3 per cent of the total income for electric service for all central stations, they reported 46 per cent of the total income for current sold to other public service corporations.

Table 20 (p. 38) presents detailed power statistics for the hydroelectric stations reporting water power of 1,000 or more horsepower, by geographic divisions and states, for 1912.

This table shows that in five of the geographic divisions the water power of the hydroelectric stations amounted to more than 200,000 horsepower. In the Middle Atlantic states it amounted to 614,396 horsepower, or 26.8 per cent of the total; in the Pacific states, to 525,567, or 23 per cent; in the South Atlantic states, to 323,081, or 14.1 per cent; in the Mountain states, to 296,034, or 12.9 per cent; and in the East North Central states, to 228,602, or 10 per cent. The four remaining divisions combined reported 300,716 horsepower, or 13.2 per cent.

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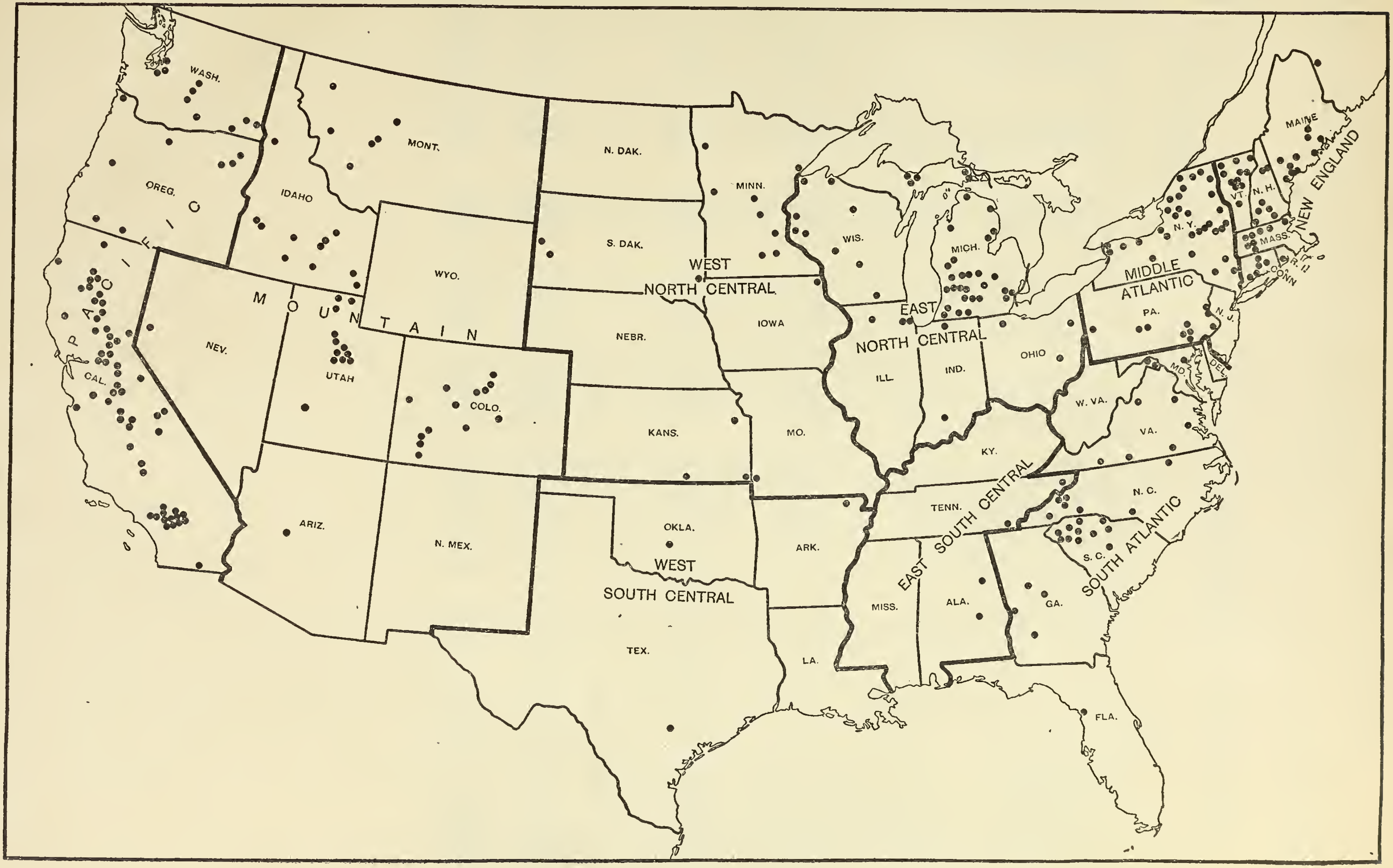
[1] Report of the Commissioner of Corporations on water-power development in the United States: 1912.

Map 2.—LOCATION OF HYDROELECTRIC CENTRAL STATIONS REPORTING WATER POWER OF 1,000 HORSEPOWER OR MORE, BY GEOGRAPHIC DIVISIONS: 1912.


PACIFIC
MOUNTAIN
WEST NORTH CENTRAL
EAST NORTH CENTRAL
MIDDLE ATLANTIC
NEW ENGLAND
WEST SOUTH CENTRAL
EAST SOUTH CENTRAL
SOUTH ATLANTIC
WASH.
OREG.
CAL.
IDAHO
NEV.
MONT.
WYO.
UTAH
COLO.
ARIZ.
N. MEX.
N. DAK.
S. DAK.
NEBR.
KANS.
OKLA.
TEX.
MINN.
IOWA
MO.
ARK.
LA.
WIS.
MICH.
ILL.
IND.
OHIO
KY.
TENN.
MISS.
ALA.
GA.
FLA.
S. C.
N. C.
VA.
W. VA.
MD.
DEL.
PA.
N. J.
N. Y.
VT.
N. H.
MAINE
MASS.
R. I.
CONN.

HYDROELECTRIC STATIONS REPORTING WATER POWER OF 1,000

	Table 20			INCOME.					
					Electric service.				
	DIVISION AND STATE.	Number of stations.	Cost of construction and equipment.	Aggregate.	Total.	Light, heat, and power.	Sale of electric current to other public service corporations.	Estimated value of free service.	All other income.
1	UNITED STATES	225	$922,954,341	$72,717,582	$66,852,631	$52,445,534	$14,269,708	$137,389	$5,864,951
	GEOGRAPHIC DIVISIONS:								
2	New England	40	55,612,714	7,509,541	7,000,257	5,769,650	1,179,483	51,124	509,284
3	Middle Atlantic	39	127,457,618	11,538,580	9,238,299	6,520,607	2,711,572	6,120	2,300,281
4	East North Central	29	102,470,585	12,164,623	11,179,326	8,601,917	2,570,668	6,741	985,297
5	West North Central	16	38,657,925	4,432,394	4,124,859	3,492,522	629,047	3,290	307,535
6	South Atlantic	30	55,757,646	2,990,998	2,930,024	1,578,558	1,338,186	13,280	60,974
7	East South Central	4	30,828,000	480,867	470,357	221,261	248,846	250	10,510
8	West South Central	3	539,369	70,715	69,363	69,135	...	228	1,352
9	Mountain	32	164,975,643	7,665,587	7,043,061	6,108,526	903,122	31,413	622,526
10	Pacific	32	346,654,841	25,864,277	24,797,085	20,083,358	4,688,784	24,943	1,067,192
	NEW ENGLAND:								
11	Maine	9	16,533,547	1,449,825	1,181,952	929,826	251,564	562	267,873
12	New Hampshire	7	9,444,366	1,148,253	1,053,353	603,178	450,175	...	94,900
13	Vermont	11	6,863,716	678,170	657,579	583,927	23,240	50,412	20,591
14	Massachusetts	7	7,395,591	1,668,369	1,648,793	1,628,685	20,108	...	19,576
15	Rhode Island and Connecticut	6	15,375,494	2,564,924	2,458,580	2,024,034	434,396	150	106,344
	MIDDLE ATLANTIC:								
16	New York	30	89,409,903	9,328,380	7,124,772	5,514,488	1,605,539	4,745	2,203,608
17	Pennsylvania	9	38,047,715	2,210,200	2,113,527	1,006,119	1,106,033	1,375	96,673
	EAST NORTH CENTRAL:								
18	Ohio and Indiana	5	11,986,199	1,268,196	1,239,211	963,332	274,708	1,171	28,985
19	Illinois	3	37,398,019	4,327,160	3,618,732	3,376,049	239,533	3,150	708,428
20	Michigan	13	39,441,726	5,845,270	5,606,566	4,085,583	1,518,563	2,420	238,704
21	Wisconsin	8	13,644,641	723,997	714,817	176,953	537,864	...	9,180
	WEST NORTH CENTRAL:								
22	Minnesota, Iowa, and Missouri	10	22,132,484	3,794,840	3,518,053	2,931,003	586,360	690	276,787
23	South Dakota	3	7,758,185	463,170	441,772	422,894	16,378	2,500	21,398
24	Kansas	3	8,767,256	174,384	165,034	138,625	26,309	100	9,350
	SOUTH ATLANTIC:								
25	Maryland, Virginia, and West Virginia	9	9,666,636	417,109	415,436	364,590	40.666	10,180	1,673
26	North Carolina	5	8,739,185	300,377	280,682	177,527	103,155	...	17,601
27	South Carolina	11	21,791,806	1,624,275	1,614,817	639,842	971,875	3,100	10,947
28	Georgia and Florida	5	15,560,019	649,237	619,089	396,599	222,490	...	30,753
	EAST SOUTH CENTRAL:								
29	Tennessee and Alabama	4	30,828,000	480,867	470,357	221,261	248,846	250	10,510
	WEST SOUTH CENTRAL:								
30	Arkansas, Oklahoma, and Texas	3	539,369	70,715	69,363	69,135	...	228	1,352
	MOUNTAIN:								
31	Montana	4	62,667,126	3,265,885	2,708,869	2,633,768	74,441	660	557,016
32	Idaho	10	29,532,755	1,173,500	1,148,092	962,890	162,645	22,557	25,408
33	Colorado	10	45,044,966	1,483,697	1,455,133	1,027,904	426,208	1,021	28,564
34	Arizona and Nevada	3	18,485,461	681,004	675,335	643,474	31,861	...	5,669
35	Utah	5	9,245,335	1,061,501	1,055,632	840,490	207,967	7,175	5,869
	PACIFIC:								
36	Washington	6	18,193,923	2,207,308	2,146,921	2,077,130	57,440	12,351	60,387
37	Oregon	4	16,521,752	653,701	637,074	623,342	9,232	4,500	16,627
38	California	22	311,939,166	23,003,268	22,013,090	17,382,886	4,622,112	8,092	990,178

HORSEPOWER OR MORE, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

Total expenses, including salaries and wages.	Total number of persons employed.	PRIMARY POWER.													
		Aggregate.		Steam engines.											
				Total.		500 horsepower or under.		Over 500 and under 2,000 horsepower.		2,000 and under 5,000 horsepower.		5,000 horsepower and over.			
		Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.		
$56,342,064	17,160	2,091	3,179,244	329	205,033	227	59,507	76	65,966	23	57,060	3	22,500	1	
5,235,075	1,758	359	286,988	59	27,300	41	12,775	18	14,525	...	...	...	...	2	
8,100,824	2,305	401	706,171	81	48,100	57	18,050	18	17,550	6	12,500	...	...	3	
10,310,318	4,317	455	472,544	81	26,343	65	11,142	14	11,041	2	4,160	...	...	4	
3,354,565	934	119	144,430	22	10,675	19	5,725	2	1,450	1	3,500	...	...	5	
1,924,679	587	184	345,770	10	3,390	8	1,640	2	1,750	...	...	...	...	6	
509,649	148	17	36,480	3	1,740	2	890	1	850	...	...	...	...	7	
55,208	27	15	5,985	1	650	...	...	1	650	...	...	...	...	8	
5,958,205	1,329	212	314,799	20	6,585	17	3,585	3	3,000	...	...	...	...	9	
20,893,541	5,755	329	866,077	52	80,250	18	5,700	17	15,150	14	36,900	3	22,500	10	
1,082,656	392	133	70,154	20	7,500	18	6,100	2	1,400	...	...	...	...	11	
642,649	210	61	52,942	8	4,925	4	1,750	4	3,175	...	...	...	...	12	
435,883	176	41	30,379	5	2,200	4	1,450	1	750	...	...	...	...	13	
1,195,862	420	54	61,643	6	3,225	4	1,075	2	2,150	...	...	...	...	14	
1,878,025	560	70	71,870	20	9,450	11	2,400	9	7,050	...	...	...	...	15	
6,421,585	1,896	313	564,984	65	42,033	41	11,983	18	17,550	6	12,500	...	...	16	
1,679,239	409	88	141,187	16	6,067	16	6,067	...	...	...	...	...	...	17	
999,076	274	93	49,732	4	2,350	1	350	3	2,000	...	...	...	...	18	
3,356,189	1,749	148	87,402	56	10,540	54	8,500	2	2,040	...	...	...	...	19	
5,387,908	2,191	153	277,510	16	12,453	5	1,292	9	7,001	2	4,160	...	...	20	
567,145	103	61	57,900	5	1,000	5	1,000	...	...	...	...	...	...	21	
2,737,144	614	78	90,884	17	5,775	15	4,325	2	1,450	...	...	...	...	22	
400,963	99	21	16,276	2	800	2	800	...	...	...	...	...	...	23	
216,458	221	20	37,270	3	4,100	2	600	...	...	1	3,500	...	...	24	
315,794	159	45	52,786	4	1,000	3	600	1	1,000	...	...	...	...	25	
259,398	116	24	46,790	4	790	4	790	...	...	...	...	...	...	26	
752,590	210	81	186,869	...	...	...	...	...	...	...	...	...	...	27	
596,897	102	34	59,325	2	1,000	1	250	1	750	...	...	...	...	28	
509,649	148	17	36,480	3	1,740	2	890	1	850	...	...	...	...	29	
55,208	27	15	5,985	1	650	...	...	1	650	...	...	...	...	30	
1,936,818	373	62	107,795	7	1,125	7	1,125	...	...	...	...	...	...	31	
1,213,662	227	45	49,159	1	150	1	150	...	...	...	...	...	...	32	
1,529,887	331	58	83,805	11	5,010	8	2,010	3	3,000	...	...	...	...	33	
411,796	149	14	21,340	...	...	...	...	...	...	...	...	...	...	34	
866,042	249	33	52,700	1	300	1	300	...	...	...	...	...	...	35	
1,483,080	813	45	81,940	4	1,300	3	550	1	750	...	...	...	...	36	
560,400	272	25	25,250	4	2,350	2	800	2	1,550	...	...	...	...	37	
18,850,061	4,670	259	758,887	44	76,600	13	4,350	14	12,850	14	36,900	3	22,500	38	

HYDROELECTRIC STATIONS REPORTING WATER POWER OF 1,000

Table 20—Continued.

	DIVISION AND STATE.	PRIMARY POWER—continued.											
		Steam turbines.										Gas and oil engines.	
		Total.		500 horsepower or under.		Over 500 and under 2,000 horsepower.		2,000 and under 5,000 horsepower.		5,000 horsepower and over.		Total.	
		Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.
1	UNITED STATES	191	680,129	8	1,705	94	95,295	53	162,482	36	420,647	19	5,686
	GEOGRAPHIC DIVISIONS:												
2	New England	39	89,879	......	......	22	25,564	13	40,613	4	23,702	2	450
3	Middle Atlantic	27	43,675	2	500	18	13,982	5	14,193	2	15,000	......	......
4	East North Central	51	216,533	......	......	29	31,313	10	35,780	12	149,440	4	1,066
5	West North Central	17	38,703	4	670	8	7,366	3	6,667	2	24,000	7	2,135
6	South Atlantic	11	18,999	......	......	5	5,666	6	13,333	......	......	1	300
7	East South Central	1	1,340	......	......	1	1,340	......	......	......	......	......	......
8	West South Central	......	......	......	......	......	......	......	......	......	......	2	295
9	Mountain	9	12,180	2	535	4	3,645	3	8,000	......	......	......	......
10	Pacific	36	258,820	......	......	7	6,419	13	43,896	16	208,505	3	1,440
	NEW ENGLAND:												
11	Maine	2	3,420	......	......	1	670	1	2,750	......	......	......	......
12	New Hampshire	......	......	......	......	......	......	......	......	......	......	2	450
13	Vermont	5	5,201	......	......	5	5,201	......	......	......	......	......	......
14	Massachusetts	16	37,058	......	......	9	10,173	6	20,183	1	6,702	......	......
15	Rhode Island and Connecticut	16	44,200	......	......	7	9,520	6	17,680	3	17,000	......	......
	MIDDLE ATLANTIC:												
16	New York	15	30,925	2	500	8	7,065	3	8,360	2	15,000	......	......
17	Pennsylvania	12	12,750	......	......	10	6,917	2	5,833	......	......	......	......
	EAST NORTH CENTRAL:												
18	Ohio and Indiana	9	18,866	......	......	5	4,466	4	14,400	......	......	1	466
19	Illinois	15	40,200	......	......	10	10,730	2	6,030	3	23,440	2	550
20	Michigan	26	156,797	......	......	13	15,447	4	15,350	9	126,000	......	......
21	Wisconsin	1	670	......	......	1	670	......	......	......	......	1	50
	WEST NORTH CENTRAL:												
22	Minnesota, Iowa, and Missouri	4	3,650	......	......	4	3,650	......	......	......	......	6	1,985
23	South Dakota	9	9,053	4	670	2	1,716	3	6,667	......	......	......	......
24	Kansas	4	26,000	......	......	2	2,000	......	......	2	24,000	1	150
	SOUTH ATLANTIC:												
25	Maryland, Virginia, and West Virginia	4	6,000	......	......	2	2,000	2	4,000	......	......	1	300
26	North Carolina	......	......	......	......	......	......	......	......	......	......	......	......
27	South Carolina	5	9,999	......	......	2	2,666	3	7,333	......	......	......	......
28	Georgia and Florida	2	3,000	......	......	1	1,000	1	2,000	......	......	......	......
	EAST SOUTH CENTRAL:												
29	Tennessee and Alabama	1	1,340	......	......	1	1,340	......	......	......	......	......	......
	WEST SOUTH CENTRAL:												
30	Arkansas, Oklahoma, and Texas	......	......	......	......	......	......	......	......	......	......	2	295
	MOUNTAIN:												
31	Montana	3	6,500	1	500	......	......	2	6,000	......	......	......	......
32	Idaho	......	......	......	......	......	......	......	......	......	......	......	......
33	Colorado	6	5,680	1	35	4	3,645	1	2,000	......	......	......	......
34	Arizona and Nevada	......	......	......	......	......	......	......	......	......	......	......	......
35	Utah	......	......	......	......	......	......	......	......	......	......	......	......
	PACIFIC:												
36	Washington	5	7,335	......	......	3	2,669	2	4,666	......	......	......	......
37	Oregon	......	......	......	......	......	......	......	......	......	......	......	......
38	California	31	251,485	......	......	4	3,750	11	39,230	16	208,505	3	1,440

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[1] Contains 4,104 lamps of other varieties (Nernst, vacuum, vapor, etc.).

HORSEPOWER OR MORE, BY GEOGRAPHIC DIVISIONS AND STATES: 1912—Continued.

PRIMARY POWER—continued.										DYNAMOS.		Output of station (kilowatt hours) generated during year.	ESTIMATED NUMBER OF LAMPS WIRED FOR SERVICE.		STATIONARY MOTORS SERVED.		
Water wheels and turbines.																	
Total.		500 horsepower or under.		Over 500 and under 2,000 horsepower.		2,000 and under 5,000 horsepower.		5,000 horsepower and over.		Number.	Kilowatts.		Are.	Incandescent and other varieties.	Number.	Horsepower.	
Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.								
1,552	2,288,396	633	162,693	619	582,857	150	493,760	150	1,049,086	1,925	1,951,397	5,859,397,943	62,624	[1] 13,403,893	73,645	1,283,769	1
259	169,359	156	37,333	88	81,926	13	40,100	2	10,000	327	195,630	411,094,646	8,295	1,436,941	10,594	100,847	2
293	614,396	113	33,679	102	99,417	24	65,800	54	415,500	423	359,215	1,399,488,481	11,305	1,261,849	8,937	110,080	3
319	228,602	169	41,027	124	86,375	24	86,800	2	14,400	327	294,092	787,211,604	9,083	3,052,072	15,820	143,971	4
73	92,917	44	9,179	22	16,238	5	49,500	2	18,000	100	87,545	212,978,506	4,624	861,129	6,229	77,296	5
162	323,081	40	12,071	69	75,110	17	46,500	36	189,400	183	213,873	485,867,328	2,206	156,669	2,974	100,952	6
13	33,400	......	......	8	11,800	5	21,600	......	......	24	25,375	55,770,810	819	78,468	231	4,484	7
12	5,040	8	2,340	4	2,700	......	......	......	......	13	2,740	1,335,375	104	11,511	168	1,257	8
183	296,034	45	11,016	104	111,218	20	71,800	14	102,000	204	183,446	758,364,280	3,538	648,623	4,757	170,598	9
238	525,567	58	16,048	98	98,073	42	111,660	40	299,786	324	589,481	1,747,286,913	22,650	5,896,631	23,935	574,284	10
111	59,234	72	13,989	35	29,845	2	5,400	2	10,000	98	47,296	106,028,123	1,120	232,261	1,555	25,624	11
51	47,567	31	8,467	12	11,100	8	28,000	......	......	53	37,765	90,297,891	1,144	118,336	710	7,494	12
31	22,978	13	5,216	17	15,762	1	2,000	......	......	41	17,042	43,598,562	493	177,270	1,092	15,913	13
32	21,360	17	4,341	13	12,319	2	4,700	......	......	76	43,512	60,819,611	3,439	427,726	3,172	20,899	14
34	18,220	23	5,320	11	12,900	......	......	......	......	59	50,015	110,350,459	2,099	481,348	4,065	30,917	15
233	492,026	94	28,517	67	66,709	24	65,800	48	331,000	331	261,000	1,081,292,900	9,744	971,934	7,668	84,458	16
60	122,370	19	5,162	35	32,708	......	......	6	84,500	92	98,215	318,195,581	1,561	289,915	1,269	25,622	17
79	28,050	72	18,850	7	9,200	......	......	......	......	34	28,850	71,213,325	1,212	152,212	2,105	19,162	18
75	36,112	27	6,082	48	30,030	......	......	......	......	142	49,602	175,375,156	4,418	1,023,935	3,780	28,384	19
111	108,260	34	9,915	63	40,345	12	43,600	2	14,400	110	181,585	436,971,110	3,081	1,834,830	9,515	92,330	20
54	56,180	36	6,180	6	6,800	12	43,200	......	......	41	34,055	103,652,013	372	41,095	420	4,095	21
51	79,474	35	7,224	11	9,250	3	45,000	2	18,000	64	52,558	138,486,277	4,026	761,513	5,324	62,718	22
10	6,423	......	......	10	6,423	......	......	......	......	24	11,897	17,200,554	472	78,113	720	10,313	23
12	7,020	9	1,955	1	565	2	4,500	......	......	12	23,090	57,291,675	126	21,503	185	4,265	24
36	44,886	15	4,616	14	11,270	3	9,000	4	20,000	42	35,665	29,035,776	1,654	107,894	512	7,473	25
20	46,000	4	1,500	8	6,500	2	5,000	6	33,000	26	32,431	55,725,300	110	12,361	527	19,070	26
76	176,870	11	4,130	35	39,640	8	18,700	22	114,400	86	109,877	333,633,641	321	28,450	855	36,335	27
30	55,325	10	1,825	12	17,700	4	13,800	4	22,000	29	35,900	67,472,611	121	7,964	1,080	38,074	28
13	33,400	......	......	8	11,800	5	21,600	......	......	24	25,375	55,770,810	819	78,468	231	4,484	29
12	5,040	8	2,340	4	2,700	......	......	......	......	13	2,740	1,335,375	104	11,511	168	1,257	30
52	100,170	11	3,157	26	26,613	9	34,400	6	36,000	61	68,920	371,799,054	1,602	267,069	1,462	71,059	31
44	49,009	16	3,584	24	22,425	2	6,000	2	17,000	38	31,024	105,914,621	1,084	183,856	1,287	19,836	32
41	73,115	15	3,815	19	17,300	2	8,000	5	44,000	60	37,167	144,364,518	498	140,852	957	26,240	33
14	21,340	2	60	9	12,280	3	9,000	......	......	10	13,500	58,977,145	321	24,593	594	18,246	34
32	52,400	1	400	26	32,600	4	14,400	1	5,000	35	32,835	77,308,942	33	32,253	457	35,217	35
36	73,305	17	4,005	9	9,500	3	6,800	7	53,000	35	47,005	62,233,028	4,180	625,275	1,739	22,950	36
21	22,900	2	800	18	17,100	......	......	1	5,000	31	19,120	35,993,935	579	171,854	632	8,630	37
181	429,362	39	11,243	71	71,473	39	104,860	32	241,786	258	523,356	1,649,059,950	17,891	5,099,502	21,564	542,704	38

Six of the individual states reported upward of 100,000 water horsepower each, ranking as follows: New York, 492,026 horsepower, or 21.5 per cent of the total water power; California, 429,362, or 18.8 per cent; South Carolina, 176,870, or 7.7 per cent; Pennsylvania, 122,370, or 5.3 per cent; Michigan, 108,260, or 4.7 per cent; and Montana, 100,170, or 4.4 per cent—these six states combined reporting 62.4 per cent of the total water power of the hydroelectric stations.

In addition to the 2,288,396 water horsepower shown for the central electric stations that reported 1,000 or more water horsepower each, there are a number of hydroelectric stations of 1,000 or more horsepower capacity of water wheels or turbines included among the street and electric railway plants. The total reported by such companies was 461,513 horsepower, making a grand total for the two classes of stations in 1912 of 2,749,909 water horsepower, or 93.5 per cent of the total water power reported by the central stations and electric railways combined.

Gas and oil engines.—Internal-combustion engines were reported for 713 central stations in 1912, compared with 294 stations in 1907 and 101 in 1902. Table 21 shows the number and horsepower of the internal-combustion engines reported for commercial and municipal plants, respectively, for 1912, 1907, and 1902, also the per cent of the number and horsepower in each class of stations, and per cent of increase.

Table 21

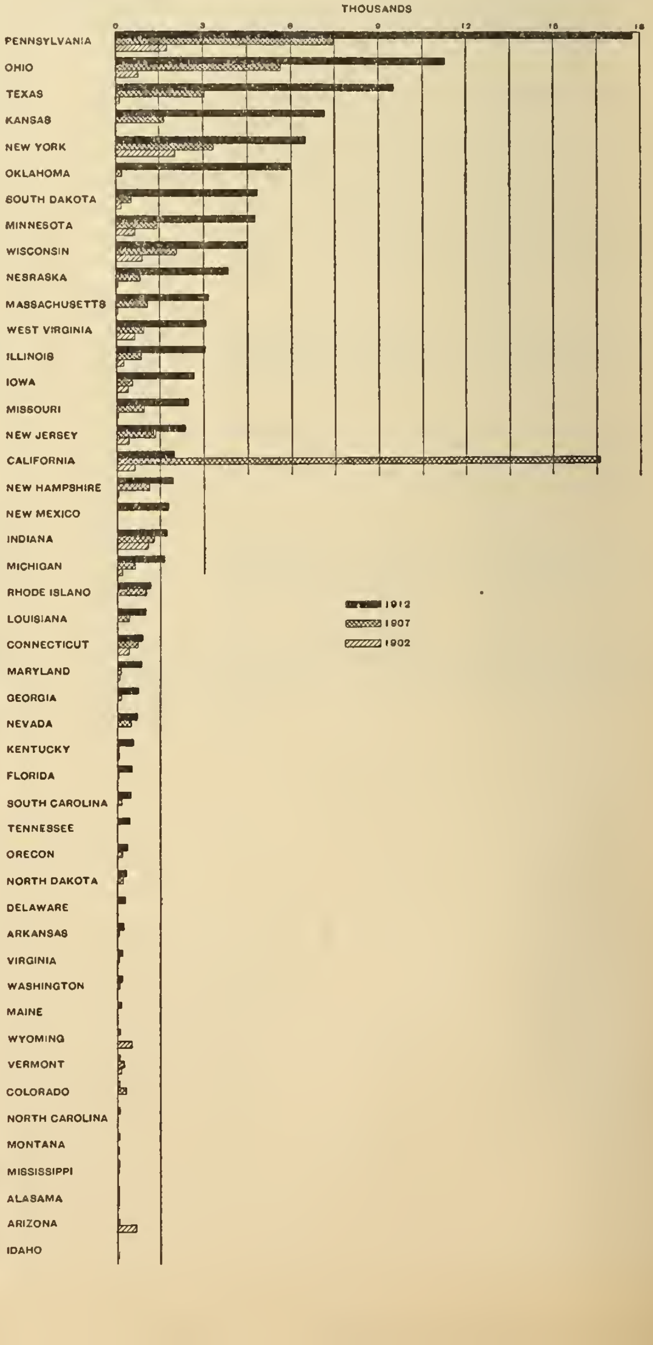
COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—GAS AND OIL ENGINES: 1912, 1907, AND 1902.

CLASS OF STATIONS.	Gas and oil engines.		Per cent of total.	
	Number.	Horsepower.	Number.	Horsepower.
Total:				
1912	1,116	111,035	100.0	100.0
1907	463	55,828	100.0	100.0
1902	165	12,181	100.0	100.0
Commercial:				
1912	833	88,634	74.6	79.8
1907	385	49,746	83.2	89.1
1902	147	11,224	89.1	92.1
Municipal:				
1912	283	22,401	25.4	20.2
1907	78	6,082	16.8	10.9
1902	18	957	10.9	7.9
PER CENT OF INCREASE.				
Total:				
1902–1912	576.4	811.5		
1907–1912	141.0	98.9		
1902–1907	180.6	358.3		
Commercial:				
1902–1912	466.7	689.7		
1907–1912	116.4	78.2		
1902–1907	161.9	343.2		
Municipal:				
1902–1912	1,472.2	2,240.8		
1907–1912	262.8	268.3		
1902–1907	333.3	535.5		

Although there are a number of large internal-combustion engines in use, the average horsepower per machine is much smaller than that of either steam or water. The horsepower reported for gas and oil engines in 1912 was 111,035, compared with 12,181 in 1902. Of the total horsepower reported in 1912, 88,634 horsepower, or 79.8 per cent, was reported by commercial stations, while municipal stations reported 22,401, or 20.2 per cent. Of the total primary power of all kinds for municipal stations (559,328 horsepower), that for gas and oil engines formed but 4 per cent, and yet of the total primary power of these internal-combustion engines for all central stations the proportion reported by the municipal stations was much greater than that for either steam or water.

The utilization of internal-combustion engines in central stations is of comparatively recent origin. In 1902 there were 165 of these engines, and they formed only 2.1 per cent of the total of prime movers in central stations, while their horsepower formed seven-tenths of 1 per cent of the total power. Notwithstanding an increase in the number of these machines to 1,116, or 9.4 per cent of all prime movers, their horsepower was equal to only 1.5 per cent of the total for all classes of primary power in 1912.

Diagram 8.—Central Electric Stations—Gas and Oil Engines, Horsepower, by States: 1912, 1907, and 1902.



CHAPTER IV.

GENERATING EQUIPMENT AND OUTPUT OF STATIONS.

Dynamos.—Except for the dynamos in the isolated electric plants and the comparatively unimportant equipment of this character in the telegraph and telephone offices, the totals for the central stations and electric railways practically represent all the dynamos installed for commercial and municipal uses in the respective census years. The totals for 1912 include the statistics of two stations located in New Brunswick, but reported with those for the state of Maine. Most of the current generated at these two stations was disposed of in Maine, and since for that reason they were included with the stations in that state in 1907, the same action was deemed advisable in 1912. The total dynamo capacity of these two stations was 2,930 kilowatts, and forms 3.3 per cent of the total dynamo capacity reported for the state.

The generating equipment of the stations was divided into three classes of dynamos, namely, direct-current constant voltage, direct-current constant amperage, and alternating and polyphase current. In the early days of the industry the direct-current constant-voltage dynamos were used almost exclusively for incandescent lighting and power, while constant-amperage dynamos furnished current for arc lighting circuits, but although the direct-current dynamos are still in use, they are giving way to the alternating- and polyphase-current machines. Alternating-current dynamos have steadily grown in favor because electricity generated by them can be transmitted long distances and the use of transformers renders the current available for all kinds of lighting and power.

Statistics of the dynamo equipment of central electric stations and electric railways, showing the number and kilowatt capacity of the three types of dynamos, are presented in Table 22, for 1912, 1907, and 1902.

CENTRAL ELECTRIC STATIONS AND ELECTRIC RAILWAYS—NUMBER, KIND, AND KILOWATT CAPACITY OF DYNAMOS: 1912, 1907, AND 1902.

Table 22	Total.		KIND OF DYNAMOS.					
			Direct current, constant voltage.		Direct current, constant amperage.		Alternating and polyphase current.	
	Number.	Kilowatt capacity.	Number.	Kilowatt capacity.	Number.	Kilowatt capacity.	Number.	Kilowatt capacity.
Total:								
1912	15,393	7,642,755	4,967	1,161,213	820	82,152	9,606	6,399,390
1907	15,297	4,432,641	5,872	1,347,962	1,685	80,992	7,740	3,003,687
1902	15,786	2,110,597	6,684	1,055,411	3,539	145,866	5,563	909,320
Central stations:								
1912	12,597	5,134,689	3,401	429,662	745	43,828	8,451	4,661,199
1907	12,173	2,709,225	3,680	406,460	1,685	80,992	6,808	2,221,773
1902	12,484	1,212,235	3,823	330,065	3,539	145,866	5,122	736,304
Electric railways:								
1912	2,796	2,508,066	1,566	731,551	75	38,324	1,155	1,738,191
1907	3,124	1,723,416	2,192	941,502	(1)	(1)	932	781,914
1902	3,302	898,362	2,861	725,346	(1)	(1)	441	173,016
	PER CENT OF INCREASE.[2]							
Total:								
1902–1912	−2.5	262.1	−25.7	10.0	−76.8	−43.7	72.7	603.8
1907–1912	(3)	72.4	−15.4	−13.9	−51.3	1.4	24.1	113.1
1902–1907	−3.1	110.0	−12.1	27.7	−52.4	−44.5	39.1	230.3
Central stations:								
1902–1912	0.9	323.6	−11.0	30.2	−78.9	−70.0	65.0	533.1
1907–1912	3.5	89.5	−7.6	5.7	−55.8	−45.9	24.1	109.8
1902–1907	−2.5	123.5	−3.7	23.1	−52.4	−44.5	32.9	201.7
Electric railways:								
1902–1912	−15.3	179.2	−45.3	0.9	....	....	161.9	904.6
1907–1912	−10.5	45.5	−28.6	−22.3	....	....	23.9	122.3
1902–1907	−5.4	91.8	−23.4	29.8	....	....	111.3	351.9

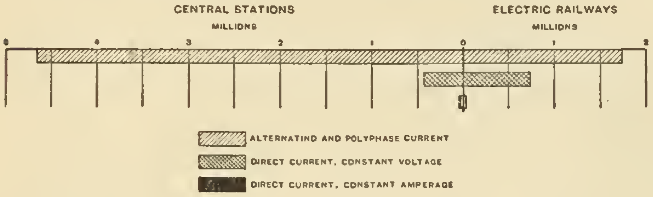
[1] Not reported separately.

[2] A minus sign (−) denotes decrease.

[3] Less than one-tenth of 1 per cent.

The number of dynamos in central electric and electric railway stations combined was 15,393 in 1912, compared with 15,786 in 1902, a decrease of 393, or 2.5 per cent, for the decade. In contrast with the decrease in the number of dynamos, the total capacity of these machines increased from 2,110,597 kilowatts in 1902 to 7,642,755 in 1912, a gain of 5,532,158 kilowatts, or 262.1 per cent, during the decade. Of this increase, 3,922,454 kilowatts, or 70.9 per cent, was contributed by central stations. Of the total kilowatt capacity for the two branches of the industry combined, the alternating-current machines reported 83.7 per cent in 1912 and 43.1 per cent in 1902, and the direct-current dynamos (the two types combined) 16.3 per cent and 56.9 per cent, respectively.

Diagram 9.—Central Electric Stations and Electric Railways—Kilowatt Capacity of Dynamos: 1912.



Although there was an increase in the capacity of the direct-current constant-voltage dynamos in both central stations and electric railway plants during the decade, a better index of later conditions pertaining to the use of this dynamo is furnished by a comparison of the totals for 1907 and 1912. The central stations reported an increase of 23,202 kilowatts, or 5.7 per cent, between 1907 and 1912, but for the electric railways there was a decrease of 209,951 kilowatts, or 22.3 per cent. The proportion which the kilowatt capacity of the constant-voltage dynamos formed of the capacity of all types for central stations and electric railway plants combined was 15.2 per cent in 1912, compared with 30.4 per cent in 1907 and 50 per cent in 1902. The corresponding percentages for central stations were 8.4, 15, and 27.2, and for plants operated by electric railways, 29.2, 54.6, and 80.7, respectively.

In 1902 and 1907 the schedule used for electric railways did not distinguish between the direct-current constant-voltage dynamo and the direct-current constant-amperage, reporting both classes as direct-current machines. In making a comparison, therefore, of the total capacity of these dynamos both classes should be combined. Such a comparison for 1902 and 1912 shows an increase of 42,088 kilowatts, or 3.5 per cent, during the decade.

The alternating-current dynamos showed the largest actual and percentage gain between 1902 and 1912 and also between 1907 and 1912. The total capacity of the machines of this type increased 5,490,070 kilowatts, or 603.8 per cent, from 1902 to 1912. Of this increase, 3,924,895 kilowatts, or 71.5 per cent, was contributed by the central stations. Between 1907 and 1912 the total increase was 3,395,703 kilowatts, or 113.1 per cent, of which 2,439,426 kilowatts, or 71.8 per cent, was contributed by the central electric stations. The increasing use of alternating-current dynamos is demonstrated by the proportions of the total kilowatt capacity for these machines in the several census years. For all stations combined these proportions were 83.7 per cent in 1912, 67.8 per cent in 1907, and 43.1 per cent in 1902. For the central stations the corresponding percentages were 90.8, 82, and 60.7, while for the electric railways they were 69.3, 45.4, and 19.3, respectively.

There were 12,597 dynamos of all kinds reported for the 5,221 central stations covered by the census of 1912. This would make an average of more than two machines for each station.

Table 23 gives for commercial and municipal central electric stations the numbers which reported the several classes of dynamos for 1912, 1907, and 1902.

Table 23

COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—NUMBER OF STATIONS, BY KIND OF DYNAMO: 1912, 1907, AND 1902.

KIND OF DYNAMO.	Census.	Total.	Commercial.	Municipal.
Direct current, constant voltage	1912	1,500	1,165	335
	1907	1,588	1,273	315
	1902	1,447	1,195	252
Direct current, constant amperage	1912	219	148	71
	1907	542	342	200
	1902	1,160	864	296
Alternating and polyphase current	1912	3,729	2,562	1,167
	1907	3,446	2,524	922
	1902	2,634	2,069	565

The total number of stations shown in this table is in excess of the actual number of stations reported, since a single station having two or more different kinds of dynamos is reported under each class.

From 1902 to 1912 there was an increase of 53, or 3.7 per cent, in the number of stations reporting direct-current constant-voltage dynamos, but a decrease of 88, or 5.5 per cent, between 1907 and 1912. For the commercial stations, the number reporting the direct-current constant-voltage dynamos decreased slightly during the decade. The municipal stations showed an increase in the number reporting this class of dynamos at each succeeding census.

The elimination of direct-current constant-amperage dynamos as generators of electricity is emphasized by the rapid and continuous decrease in the number of stations so equipped. The total number of stations using this type of dynamo decreased 941, or 81.1 per cent, from 1902 to 1912. Commercial stations decreased 716, or 82.9 per cent, and municipal stations 225, or 76 per cent, during the same period.

On the other hand, the number of stations equipped with alternating dynamos increased by 1,095, or 41.6 per cent, during the decade. Of this increase, the commercial stations show 493, or 45 per cent, and municipal stations 602, or 55 per cent. The percentage of increase for the commercial stations during the decade was 23.8 per cent, and for the municipal stations it was 106.5 per cent.

The increase that has taken place in the average capacity of all classes of dynamos at each census since 1902 is clearly demonstrated in Table 24, which gives, for commercial and municipal central electric stations, for the different kinds of dynamos, the average kilowatt capacity per station and per machine for 1912, 1907, and 1902.

Table 24 COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—AVERAGE KILOWATT CAPACITY OF DYNAMOS, PER STATION AND PER MACHINE

KIND OF DYNAMO.	Total.			Commercial.			Municipal.		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Total kilowatt capacity:									
Average capacity—									
Per station	983	575	335	1,302	722	392	236	167	139
Per machine	408	223	97	484	256	103	134	87	62
Direct current, constant voltage:									
Average capacity—									
Per station	286	256	228	342	298	262	94	85	70
Per machine	126	110	86	141	120	92	55	52	42
Direct current, constant amperage:									
Average capacity—									
Per station	200	149	126	209	181	136	182	96	95
Per machine	59	48	41	60	50	40	57	44	48
Alternating and polyphase current:									
Average capacity—									
Per station	1,250	645	280	1,693	816	323	278	177	120
Per machine	552	326	144	667	384	156	166	113	82

The total average capacity per station, for all classes of dynamos combined, increased 648 kilowatts, or 193.4 per cent, between 1902 and 1912. For the commercial stations the total average capacity per station increased 910 kilowatts during the decade, and the corresponding increase for municipal stations was 97 kilowatts.

The average kilowatt capacity per station for each of the three groups of dynamos shows a greater or less increase at each census. The average for the alternating and polyphase current dynamos shows the greatest increase per station, 970 kilowatts, from 1902 to 1912.

From 1902 to 1912 the average capacity of all dynamos increased 310 kilowatts. Of the three classes of dynamos, the average capacity per machine for the alternating and polyphase current dynamo, for all stations, shows the greatest and the only pronounced increase during the decade—408 kilowatts, or 283.3 per cent.

Table 25 presents, for commercial and municipal electric stations, the number and kilowatt capacity of the three classes of dynamos for 1912, 1907, and 1902.

COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—NUMBER, KIND, AND KILOWATT CAPACITY OF DYNAMOS: 1912, 1907, AND 1902.

Table 25

CLASS OF STATIONS.	TOTAL.		KIND OF DYNAMOS.					
			Direct current, constant voltage.		Direct current, constant amperage.		Alternating and polyphase current.	
	Number.	Kilowatt capacity.	Number.	Kilowatt capacity.	Number.	Kilowatt capacity.	Number.	Kilowatt capacity.
Total:								
1912	12,597	5,134,689	3,401	429,662	745	43,828	8,451	4,661,199
1907	12,173	2,709,225	3,680	406,460	1,685	80,992	6,808	2,221,773
1902	12,484	1,212,235	3,823	330,065	3,539	145,866	5,122	736,304
Commercial:								
1912	9,837	4,766,012	2,821	398,046	518	30,880	6,498	4,337,086
1907	9,778	2,500,209	3,169	379,706	1,246	61,753	5,363	2,058,750
1902	10,662	1,098,855	3,405	312,509	2,957	117,695	4,300	668,651
Municipal:								
1912	2,760	368,677	580	31,616	227	12,948	1,953	324,113
1907	2,395	209,016	511	26,754	439	19,239	1,445	163,023
1902	1,822	113,380	418	17,556	582	28,171	822	67,653
	PER CENT OF INCREASE.[1]							
Total:								
1902–1912	0.9	323.6	−11.0	30.2	−78.9	−70.0	65.0	533.1
1907–1912	3.5	89.5	−7.6	5.7	−55.8	−45.9	24.1	109.8
1902–1907	−2.5	123.5	−3.7	23.1	−52.4	−44.5	32.9	201.7
Commercial:								
1902–1912	−7.7	333.7	−17.2	27.4	−82.5	−73.8	51.1	548.6
1907–1912	0.6	90.6	−11.0	4.8	−58.4	−50.0	21.2	110.7
1902–1907	−8.3	127.5	−6.9	21.5	−57.9	−47.5	24.7	207.9
Municipal:								
1902–1912	51.5	225.2	38.8	80.1	−61.0	−54.0	137.6	379.1
1907–1912	15.2	76.4	13.5	18.2	−48.3	−32.7	35.2	98.8
1902–1907	31.4	84.3	22.2	52.4	−24.6	−31.7	75.8	141.0

[1] A minus sign (—) denotes decrease.

The total kilowatt capacity of the dynamos installed in central electric stations increased 3,922,454 kilowatts, or 323.6 per cent, from 1902 to 1912. Of this increase, 3,667,157, or 93.5 per cent, was contributed by the commercial stations.

The total capacity of the direct-current constant-voltage dynamos increased 99,597 kilowatts, or 30.2 per cent, in the 10 years, of which increase the commercial stations contributed 85.8 per cent.

On the other hand, the capacity of the direct-current, constant-amperage dynamos decreased 102,038 kilowatts, or 70 per cent, during the same period. Of this decrease, 86,815 kilowatts, or 85.1 per cent, is shown for the commercial stations. The tendency to eliminate this latter type of dynamo is demonstrated by the fact that the total kilowatt capacity of constant-amperage dynamos in commercial and municipal stations combined constituted only nine-tenths of 1 per cent of the total reported for all types of dynamos in 1912, compared with 3 per cent in 1907 and 12 per cent in 1902.

The total capacity of the alternating-current dynamos in all central electric stations increased 3,924,895 kilowatts, or over 500 per cent, from 1902 to 1912. In 1902 the total kilowatt capacity of alternating dynamos located in commercial and municipal stations combined represented 60.7 per cent of the total capacity for all classes of dynamos; in 1907 this proportion was 82 per cent; and in 1912, 90.8 per cent. The kilowatt capacity of the alternating-current dynamos reported by commercial stations formed 60.8 per cent of the kilowatt capacity for all kinds of dynamos in 1902, 82.3 per cent in 1907, and 91 per cent in 1912, while for municipal stations the corresponding proportions were 59.7 per cent, 78 per cent, and 87.9 per cent.

Next to the output of the stations, the capacity of the generating equipment and the increase from census to census furnish a measure of the growth of the electrical industries. In Table 26 this growth is shown, as indicated by dynamo capacity of all central electric stations, by geographic divisions and states, for 1912, 1907, and 1902.

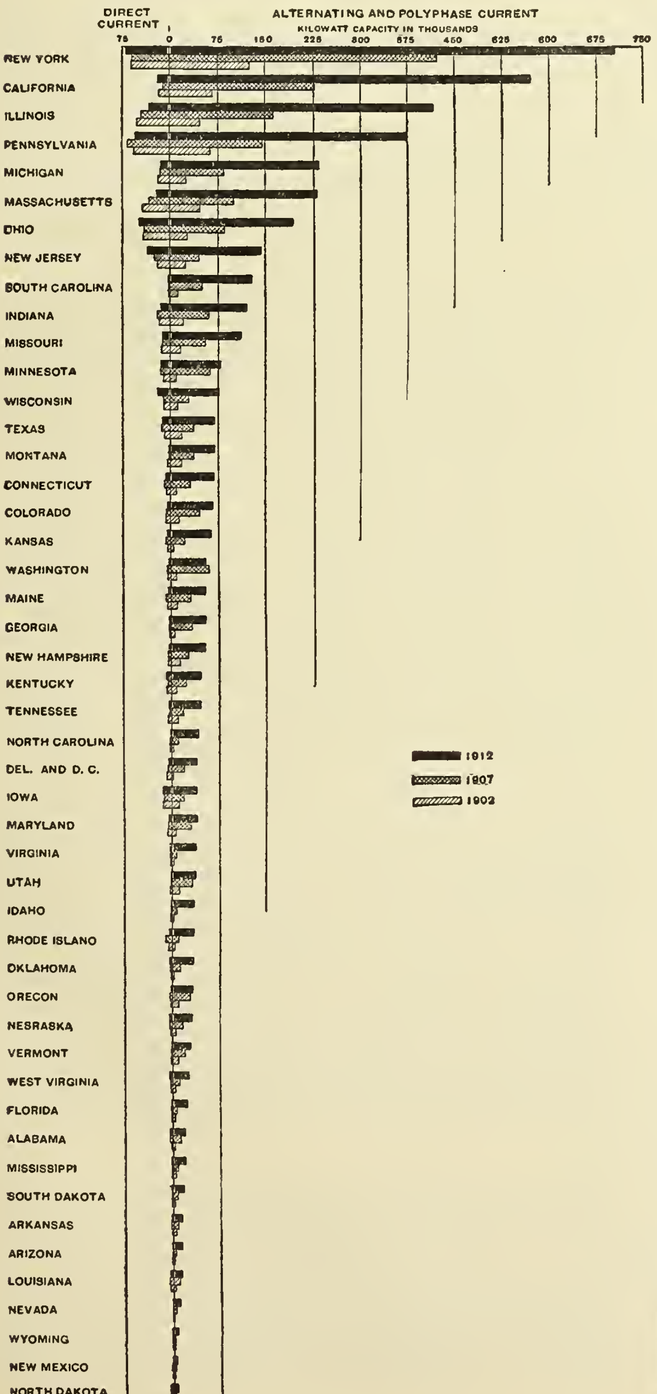
CENTRAL ELECTRIC STATIONS—TOTAL KILOWATT CAPACITY OF DYNAMOS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902.

Table 26

DIVISION AND STATE.	TOTAL KILOWATT CAPACITY OF DYNAMOS.			Actual increase: 1902–1912	Per cent of increase: 1902–1912	PER CENT DISTRIBUTION.		
	1912	1907	1902			1912	1907	1902
UNITED STATES	5,134,689	2,709,225	1,212,235	3,922,454	323.6	100.0	100.0	100.0
GEOGRAPHIC DIVISIONS:								
New England	514,889	289,388	162,789	352,100	216.3	10.0	10.7	13.4
Middle Atlantic	1,378,811	765,140	354,760	1,024,051	288.7	26.9	28.2	29.3
East North Central	1,176,528	559,760	275,569	900,959	326.9	22.9	20.7	22.7
West North Central	404,172	245,252	99,945	304,227	304.4	7.9	9.1	8.2
South Atlantic	412,779	195,309	62,301	350,478	562.6	8.0	7.2	5.1
East South Central	150,042	77,059	39,327	110,715	281.5	2.9	2.8	3.2
West South Central	158,369	88,910	42,932	115,437	268.9	3.1	3.3	3.5
Mountain	261,119	151,032	65,952	195,167	295.9	5.1	5.6	5.5
Pacific	677,980	337,375	108,660	569,320	523.9	13.2	12.5	9.0
NEW ENGLAND:								
Maine	58,757	39,290	15,291	43,466	284.3	11.4	13.6	9.4
New Hampshire	57,768	31,917	17,777	39,991	225.0	11.2	11.0	10.9
Vermont	29,468	21,854	11,442	18,026	157.5	5.7	7.6	7.0
Massachusetts	252,732	135,924	90,624	162,108	178.9	49.1	47.0	55.7
Rhode Island	38,509	21,040	12,139	26,370	217.2	7.5	7.3	7.5
Connecticut	77,655	39,363	15,516	62,139	400.5	15.1	13.6	9.5
MIDDLE ATLANTIC:								
New York	772,030	482,031	187,252	584,778	312.3	56.0	63.0	52.8
New Jersey	179,477	70,566	46,120	133,357	289.2	13.0	9.2	13.0
Pennsylvania	427,304	212,543	121,388	305,916	252.0	31.0	27.8	34.2
EAST NORTH CENTRAL:								
Ohio	244,182	126,533	69,811	174,371	249.8	20.8	22.6	25.3
Indiana	135,801	81,576	38,144	97,657	256.0	11.5	14.6	13.8
Illinois	449,917	209,226	100,320	349,597	348.5	38.2	37.4	36.4
Michigan	247,789	101,714	44,176	203,613	460.9	21.1	18.2	16.0
Wisconsin	98,839	40,711	23,118	75,721	327.5	8.4	7.3	8.4
WEST NORTH CENTRAL:								
Minnesota	93,502	78,516	20,999	72,503	345.3	23.1	32.0	21.0
Iowa	53,237	32,056	24,886	28,351	113.9	13.2	13.1	24.9
Missouri	122,786	68,467	32,100	90,686	282.5	30.4	27.9	32.1
North Dakota	10,824	5,819	2,042	8,782	430.1	2.7	2.4	2.0
South Dakota	20,032	10,046	2,910	17,122	588.3	5.0	4.1	2.9
Nebraska	34,586	20,041	8,412	26,174	311.2	8.6	8.2	8.4
Kansas	69,205	30,307	8,596	60,609	705.1	17.1	12.4	8.6
SOUTH ATLANTIC:								
Delaware, District of Columbia, and Maryland	87,137	62,956	21,639	65,498	302.7	21.1	32.2	34.8
Virginia	40,512	9,195	3,827	36,685	5.9	9.8	4.7	6.1
West Virginia	29,772	14,726	6,985	22,787	326.2	7.2	7.5	11.2
North Carolina	43,099	13,911	4,141	38,958	4.1	10.4	7.1	6.6
South Carolina	132,408	51,271	13,390	119,018	888.9	32.1	26.3	21.5
Georgia	56,232	35,446	7,620	48,612	638.0	13.6	18.1	12.2
Florida	23,619	7,804	4,699	18,920	402.6	5.7	4.0	7.5
EAST SOUTH CENTRAL:								
Kentucky	54,062	29,140	15,012	39,050	260.1	36.0	37.8	38.2
Tennessee	49,640	20,911	14,736	34,904	236.9	33.1	27.1	37.5
Alabama	24,477	17,124	4,473	20,004	447.2	16.3	22.2	11.4
Mississippi	21,863	9,884	5,106	16,757	328.2	14.6	12.8	13.0
WEST SOUTH CENTRAL:								
Arkansas	16,335	9,678	6,024	10,311	171.2	10.3	10.9	14.0
Louisiana	19,169	15,175	7,781	11,388	146.4	12.1	17.1	18.1
Oklahoma	38,301	15,499	3,019	35,282	1168.7	24.2	17.4	7.0
Texas	84,564	48,558	26,108	58,456	223.9	53.4	54.6	60.8
MOUNTAIN:								
Montana	74,398	39,602	22,055	52,343	237.3	28.5	26.2	33.4
Idaho	35,656	7,082	2,774	32,882	1185.4	13.7	4.7	4.2
Wyoming	8,212	3,208	1,831	6,381	348.5	3.1	2.1	2.8
Colorado	71,668	53,130	21,808	49,860	228.6	27.4	35.2	33.1
New Mexico	7,981	3,789	986	6,995	709.4	3.1	2.5	1.5
Arizona	14,756	4,939	1,811	12,945	714.8	5.7	3.3	2.7
Utah	37,935	33,592	13,923	24,012	172.5	14.5	22.2	21.1
Nevada	10,513	5,690	764	9,749	1276.0	4.0	3.8	1.2
PACIFIC:								
Washington	57,283	66,308	13,679	43,604	318.8	8.4	19.7	12.6
Oregon	32,416	32,587	11,165	21,251	190.3	4.8	9.7	10.3
California	588,281	238,480	83,816	504,465	601.9	86.8	70.7	77.1

Table 26 furnishes a comprehensive idea of the growth of the central electric station industry in the different geographic divisions and states. Of the total kilowatt capacity reported for the United States in 1912, four of the geographic divisions combined, namely, the Middle Atlantic, East North Central, Pacific, and New England, ranking in the order named, contributed 73 per cent. The South Atlantic division, which reported but 8 per cent of the total kilowatt capacity in 1912, showed the greatest per cent of increase during the decade, and New England the smallest per cent.

Diagram 10.—Central Electric Stations—Kilowatt Capacity of Dynamos, by States: 1912, 1907, and 1902.



Considering the relative importance of the different geographic divisions as measured by their proportions of the total, they were practically the same at all three censuses. The only change in their relative positions took place between the South Atlantic and West North Central divisions. The former, occupying fifth place in 1902, dropped to sixth in 1907, but regained fifth place in 1912, while the West North Central, which was sixth in importance in 1902, in 1907 advanced to fifth place, but in 1912 dropped back again to the sixth position.

Among the states, New York and California combined reported an actual increase in capacity of 1,089,243 kilowatts, or 27.8 per cent of the total increase for the United States, between 1902 and 1912. In addition to these two states, seven states, namely, Illinois, Pennsylvania, Michigan, Ohio, Massachusetts, New Jersey, and South Carolina, each reported an increase during the decade of 100,000 or more kilowatts in the dynamo capacity of their central stations. The combined increase for these nine states was 2,537,223 kilowatts, or 64.7 per cent of the total increase for the United States.

It appears from these figures that during the decade the remaining 39 states, together with the District of Columbia, reported a total actual increase in dynamo capacity of 1,385,231 kilowatts, or 35.3 per cent of the increase for all states combined.

Exceptionally large actual increases in dynamo capacity are shown during the decade for several of the states, among which may be mentioned New York, with 584,778 kilowatts; California, 504,465 kilowatts; Illinois, 349,597 kilowatts; and Pennsylvania, 305,916 kilowatts. Of these four states, the largest rate of increase is shown for California, 601.9 per cent. There are a number of states, however, for which larger percentages of increase are shown, but the stations were generally small or the industry but slightly developed in 1902, and, with the exception of South Carolina, none of them had a capacity of 100,000 kilowatts or more in 1912. The largest percentage of increase from 1902 to 1912 (1,276) was for Nevada, for which state the capacity increased from 764 kilowatts to 10,513 kilowatts.

As a further illustration of the growth in the dynamo capacity of the central stations, Table 27 gives for these stations their number, arranged in groups according to the total kilowatt capacity of the dynamos, by geographic divisions, for 1912 and 1907.

Of the total kilowatt capacity of dynamos in central electric stations in 1912, the Middle Atlantic division reported 26.9 per cent, the East North Central 22.9 per cent, the Pacific 13.2 per cent, and New England 10 per cent of the total for the United States. These four geographic divisions combined reported 73 per cent of the total for the United States in 1912 and 72.1 per cent in 1907. These four divisions also reported 78.7 per cent of the dynamo capacity for stations having a capacity of 5,000 kilowatts and over, compared with 78.4 per cent in 1907. This table emphasizes the growth of stations having a dynamo capacity of over 5,000 kilowatts. The total capacity of dynamos of this class increased 2,177,429, or 152 per cent, during the five-year period 1907–1912, this gain forming 89.8 per cent of the total increase for the dynamos of all groups combined. The total kilowatt capacity for this class formed 70.3 per cent of the entire dynamo equipment in central electric stations in 1912, compared with 52.9 per cent in 1907. Six of the nine geographic divisions show a decreased capacity for the smallest class of dynamos, and there was a decrease of 12,030 kilowatts, or 4.6 per cent, during the five-year period in their total for the United States. The tendency toward the use of dynamos of larger capacity is evidenced by the fact that the percentages of increase are greater for these classes than for the smaller ones.

CENTRAL ELECTRIC STATIONS—NUMBER, BY DYNAMO CAPACITY AND BY GEOGRAPHIC DIVISIONS: 1912 AND 1907.

Table 27

DIVISION.[1]	Census.	TOTAL.		STATIONS GROUPED ACCORDING TO DYNAMO CAPACITY.												Stations having no generating equipment (number).
				Under 200 kilowatts.		200 and under 500 kilowatts.		500 and under 1,000 kilowatts.		1,000 and under 2,000 kilowatts.		2,000 and under 5,000 kilowatts.		5,000 kilowatts and over.		
		Number of stations.	Kilowatt capacity.	Number of stations.	Kilowatt capacity.	Number of stations.	Kilowatt capacity.	Number of stations.	Kilowatt capacity.	Number of stations.	Kilowatt capacity.	Number of stations.	Kilowatt capacity.	Number of stations.	Kilowatt capacity.	
United States	1912	5,221	5,134,689	2,902	250,571	948	278,505	337	228,885	214	301,495	152	464,993	161	3,610,240	507
	1907	4,714	2,709,225	3,038	262,601	821	246,015	269	182,664	169	228,313	115	356,821	75	1,432,811	227
Per cent of increase[2]		10.8	89.5	−4.5	−4.6	15.5	13.2	25.3	25.3	26.6	32.1	32.2	30.3	114.7	152.0	123.3
New England	1912	368	514,889	102	9,609	64	20,300	39	27,255	36	50,260	26	79,047	24	328,418	77
	1907	365	289,388	147	13,760	74	24,544	41	27,867	35	50,415	22	66,725	9	106,077	37
Per cent of increase[2]		0.8	77.9	−30.6	−30.2	−13.5	−17.3	−4.9	−2.2	2.9	−0.3	18.2	18.5	166.7	209.6	108.1
Middle Atlantic	1912	669	1,378,811	249	23,823	144	43,851	66	46,037	43	61,815	36	108,018	32	1,095,267	99
	1907	705	765,140	334	31,928	150	46,459	72	50,424	41	52,574	28	82,889	18	500,866	62
Per cent of increase[2]		−5.1	80.2	−25.4	−25.4	−4.0	−5.6	−8.3	−8.7	4.9	17.6	28.6	30.3	77.8	118.7	59.7
East North Central	1912	1,260	1,176,528	723	64,843	241	70,782	76	50,290	54	75,376	30	96,947	30	818,290	106
	1907	1,295	559,760	906	79,935	229	66,357	70	47,633	34	41,158	22	66,334	13	258,343	21
Per cent of increase[2]		−2.7	110.2	−20.2	−18.9	5.2	6.7	8.6	5.6	58.8	83.1	36.4	46.1	130.8	216.7	404.8
West North Central	1912	1,077	404,172	760	60,340	166	47,739	54	36,761	16	23,532	12	36,515	12	199,285	57
	1907	800	245,252	621	51,556	117	34,327	25	15,714	13	17,798	5	15,420	7	110,437	12
Per cent of increase		34.6	64.8	22.4	17.0	41.9	39.1	116.0	133.9	23.1	32.2	140.0	136.8	71.4	80.5	375.0
South Atlantic	1912	512	412,779	278	24,825	107	31,313	28	18,953	17	22,394	13	35,747	15	279,547	54
	1907	390	195,309	250	22,180	90	26,663	11	7,655	10	13,758	8	21,634	7	103,419	14
Per cent of increase		31.3	111.3	11.2	11.9	18.9	17.4	154.5	147.6	70.0	62.8	62.5	65.2	114.3	170.3	285.7
East South Central	1912	330	150,042	216	18,522	69	19,499	15	10,900	8	11,384	6	17,712	8	72,025	8
	1907	284	77,059	219	19,394	46	13,285	7	4,961	3	4,795	6	23,524	1	11,100	2
Per cent of increase[2]		16.2	94.7	−1.4	−4.5	50.0	46.8	114.3	119.7	166.7	137.4		−24.7	700.0	548.9	300.0
West South Central	1912	507	158,369	362	30,697	87	23,769	24	15,175	11	16,007	9	30,172	5	42,549	9
	1907	395	88,910	311	23,625	52	15,187	13	8,865	8	12,125	6	18,608	2	10,500	3
Per cent of increase		28.4	78.1	16.4	29.9	67.3	56.5	84.6	71.2	37.5	32.0	50.0	62.1	150.0	305.2	200.0
Mountain	1912	250	261,119	107	9,791	44	13,674	24	14,996	18	25,556	8	21,200	15	175,902	34
	1907	219	151,032	119	9,975	32	9,931	20	13,302	9	12,807	10	31,067	6	73,950	23
Per cent of increase[2]		14.2	72.9	−10.1	−1.8	37.5	37.7	20.0	12.7	100.0	99.5	−20.0	−31.8	150.0	137.9	47.8
Pacific	1912	248	677,980	105	8,121	26	7,578	11	8,518	11	15,171	12	39,635	20	598,957	63
	1907	261	337,375	131	10,248	31	9,262	10	6,243	16	22,883	8	30,620	12	258,119	53
Per cent of increase[2]		−5.0	101.0	−19.8	−20.8	−16.1	−18.2	10.0	36.4	−31.2	−33.7	50.7	29.4	66.7	132.0	18.9

[1] See page 25 for states composing the several geographic divisions.

[2] A minus sign (—) denotes decrease.

Number of stations without generators.—The economy and dependability of the generation of electrical energy by large stations and the continued extension of transmission lines enable them to supply electric current to the smaller stations at a price which has made it desirable for many stations to discontinue the use of their generating equipment and to purchase current. In addition to this matter of economy of operation, no doubt another reason for the abandonment of the generating equipment of a number of plants was the concentration of stations under a single ownership.

In Table 28 are given the numbers of commercial and municipal stations that reported no generating equipment, by geographic divisions, for 1912.

In 1912 almost one-tenth (9.7 per cent) of the 5,221 central electric stations were without generating equipment. In 1907, of the 4,714 stations, 227, or 4.8 per cent, were without generators, and in 1902, of the 3,620 stations, there were 78, or 2.2 per cent, without such equipment. In 1912 the proportion of stations without generators was greater for the commercial than for the municipal stations, 10.8 per cent and 7.2 per cent, respectively. A summary of these figures is significant of the growth of the number of central electric stations reporting no generators. The proportion of stations which purchased all of the current used formed 2.2 per cent of the total number of stations in 1902, 4.8 per cent in 1907, and 9.7 per cent in 1912.

Of the several geographic divisions, the Pacific, which reported 4.8 per cent of the total number of stations, and the New England, which reported 7 per cent, show the largest proportions of stations without generating equipment, 25.4 and 20.9 per cent, respectively, of the totals for those divisions, while the East South Central and West South Central, which reported

6.3 and 9.7 per cent of all stations, had the smallest proportions without generators, 2.4 and 1.8 per cent of their respective totals.

Table 28 TOTAL NUMBER OF COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS AND NUMBER HAVING NO GENERATING EQUIPMENT, BY GEOGRAPHIC DIVISIONS: 1912.

DIVISION.[1]	Total.				Number of stations.			
	All stations.		No generating equipment.		Commercial.		Municipal.	
	Number.	Per cent of total.	Number.	Per cent of total.	Total.	No generating equipment.	Total.	No generating equipment.
United States	5,221	100.0	507	100.0	3,659	394	1,562	113
New England	368	7.0	77	15.2	311	61	57	16
Middle Atlantic	669	12.8	99	19.5	567	92	102	7
East North Central	1,260	24.1	106	20.7	786	81	474	24
West North Central	1,077	20.6	57	11.4	678	38	399	20
South Atlantic	512	9.8	54	10.7	308	31	204	23
East South Central	330	6.3	8	1.6	202	6	128	2
West South Central	507	9.7	9	1.8	385	7	122	2
Mountain	250	4.8	34	6.7	211	28	39	6
Pacific	248	4.8	63	12.4	211	50	37	13

[1] See page 25 for states composing the several geographic divisions.

Output of stations in kilowatt hours.—It is impracticable to show relative figures for the capacity of dynamos as associated with the output of stations, since there is no way to determine from the census returns the number of hours the dynamos were operated or the varying conditions, from peak load to but a fraction thereof. Neither is it possible to determine the average price per kilowatt hour from the income shown for electric service. The kilowatt-hour output represents the current as recorded at the switchboard, which is considerably in excess of the amount delivered for consumption; and in addition the recorded output includes an indeterminable amount of current taken by the stations for their own uses, for which no income is received. Again, there is a duplication of income for current which is bought and resold. Current is frequently taken for distribution and sale by the subsidiary stations of the company producing it at prices per kilowatt hour which are often matters of bookkeeping, but which, in a sense, constitute a duplication of income for the same current.

It is doubtless true, however, that the equipment of all generating stations is in accordance with the demands made upon them for electrical energy; and probably no data, therefore, furnish a better idea of the growth of the industry than the figures showing the kilowatt-hour output of all stations from 1902 to 1912.

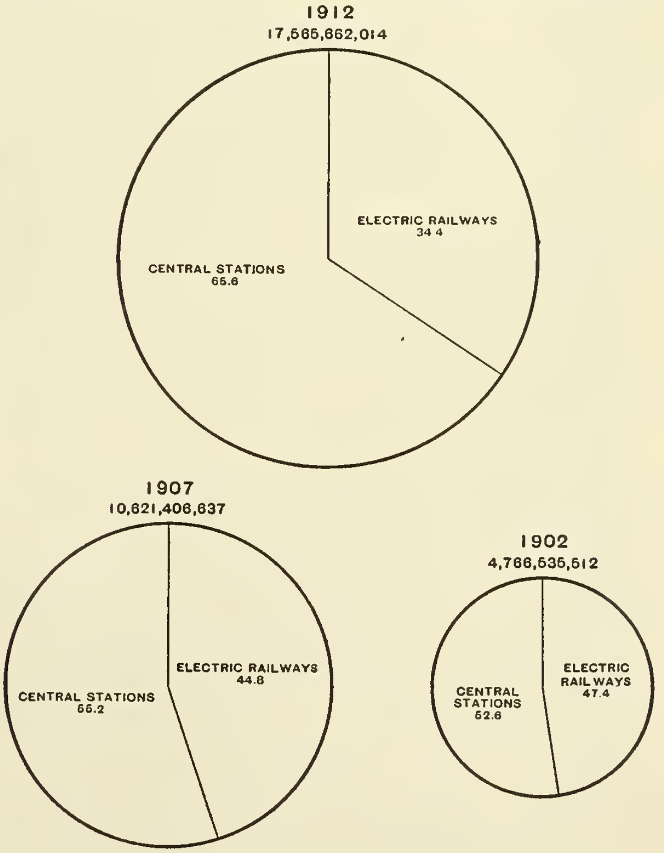
Table 29 gives for central electric stations and electric railways the kilowatt-hour output of generating stations for 1912, 1907, and 1902.

The total current generated during 1912 amounted to approximately seventeen and one-half billion kilowatt hours, an increase of 268.8 per cent for the decade and 65.6 per cent between 1907 and 1912, in contrast with an increase of 122.7 per cent between 1902 and 1907.

Table 29 CENTRAL ELECTRIC STATIONS AND ELECTRIC RAILWAYS—OUTPUT OF GENERATING STATIONS.

	1912	1907	1902
	KILOWATT HOURS.		
Total	17,585,662,014	10,621,406,837	4,768,535,512
Central stations	11,532,963,006	5,862,276,737	2,507,051,115
Commercial	10,995,436,276	5,572,813,949	2,311,146,676
Municipal	537,526,730	289,462,788	195,904,439
Electric railways	6,052,699,008	4,759,130,100	2,261,484,397
	PER CENT OF TOTAL.		
Central stations	65.6	55.2	52.6
Commercial	62.5	52.5	48.5
Municipal	3.1	2.7	4.1
Electric railways	34.4	44.8	47.4
	PER CENT OF INCREASE.		
	1902-1912	1907-1912	1902-1907
Total	268.8	65.6	122.7
Central stations	360.0	96.7	133.8
Commercial	375.8	97.3	141.1
Municipal	174.4	85.7	47.8
Electric railways	167.6	27.2	110.4

Diagram 11.—Central Electric Stations and Electric Railways—Kilowatt-Hour Output: 1912, 1907, and 1902.



In 1902 central electric stations generated 52.6 per cent of the current, while electric railways produced 47.4. The corresponding figures for 1907 were 55.2 per cent and 44.8 per cent, and in 1912 central stations reported 65.6 per cent of the total, while the proportion for electric railways had dropped to 34.4 per cent. Of the entire output of central stations, the proportion for the municipal stations has decreased at each succeeding census, forming 7.8 per cent of the total in 1902, 4.9 per cent in 1907, and 4.7 per cent in 1912. The per cent of increase in the output of the central electric stations during the decade 1902–1912 (360) was more than double that shown for the electric railways (167.6).

Table 30 shows the output of the central electric stations in kilowatt hours, by geographic divisions and states, for 1912, 1907, and 1902, together with the actual and the percentage of increase for the decade.

CENTRAL ELECTRIC STATIONS—OUTPUT OF GENERATING STATIONS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902.

Table 30

DIVISION AND STATE.	OUTPUT OF STATIONS (KILOWATT HOURS).				
	1912	1907	1902	Actual increase: 1902-1912	Per cent of increase: 1902-1912
UNITED STATES	11,532,963,006	5,862,276,737	2,507,051,115	9,025,911,891	360.0
GEOGRAPHIC DIVISIONS:					
New England	879,272,535	473,802,067	247,727,501	631,545,034	254.9
Middle Atlantic	3,548,605,305	2,009,304,160	1,021,603,500	2,527,001,805	247.4
East North Central	2,527,964,097	1,075,933,354	475,097,910	2,052,866,187	432.1
West North Central	712,595,442	386,180,647	169,964,203	542,631,239	319.3
South Atlantic	679,856,425	266,437,175	102,990,575	576,865,850	560.1
East South Central	227,664,808	118,631,967	73,750,879	153,913,929	208.7
West South Central	233,947,656	138,755,643	80,154,471	153,793,185	191.9
Mountain	845,393,882	381,032,187	145,780,112	699,613,770	479.9
Pacific	1,877,662,856	1,012,199,537	189,981,964	1,687,680,892	888.3
NEW ENGLAND:					
Maine	117,092,565	66,136,651	21,987,700	95,104,865	432.5
New Hampshire	126,593,970	55,258,921	27,377,793	99,216,177	362.4
Vermont	56,552,977	29,923,333	22,374,060	34,178,917	152.8
Massachusetts	386,254,294	219,425,607	125,813,392	260,440,902	207.0
Rhode Island	62,106,528	35,651,323	23,436,435	38,670,093	165.0
Connecticut	130,672,201	67,406,232	26,738,121	103,934,080	388.7
MIDDLE ATLANTIC:					
New York	2,175,048,634	1,452,222,471	701,769,716	1,473,278,918	209.9
New Jersey	383,891,504	140,527,552	78,739,456	305,152,048	387.6
Pennsylvania	989,665,167	416,554,167	241,094,328	748,570,839	310.5
EAST NORTH CENTRAL:					
Ohio	399,101,309	217,311,924	127,437,383	271,663,926	213.2
Indiana	236,944,000	130,263,693	75,585,493	161,358,507	213.5
Illinois	1,150,900,306	467,657,328	161,543,646	989,356,660	612.4
Michigan	525,615,508	208,154,199	80,564,630	445,050,878	552.4
Wisconsin	215,402,974	52,546,210	29,966,758	185,436,216	618.8
WEST NORTH CENTRAL:					
Minnesota	186,045,055	87,579,431	40,258,632	145,786,423	362.1
Iowa	67,166,647	37,729,072	36,506,425	30,660,222	84.0
Missouri	232,828,763	147,328,446	57,450,731	175,378,032	305.3
North Dakota	12,298,553	8,229,765	5,850,115	6,448,438	110.2
South Dakota	24,703,754	13,615,015	4,256,007	20,447,747	480.4
Nebraska	56,299,682	31,958,739	12,315,775	43,983,907	357.1
Kansas	133,252,988	59,740,179	13,326,518	119,926,470	899.9
SOUTH ATLANTIC:					
Delaware	3,412,319	4,714,074	2,794,520	617,799	22.1
Maryland [1]	23,629,117	47,868,675	22,128,125	1,500,992	6.8
District of Columbia	40,953,449	25,829,448	15,077,352	25,876,097	171.6
Virginia	28,724,684	10,208,360	6,879,243	21,845,441	317.6
West Virginia	42,344,796	24,871,317	11,355,905	30,988,891	272.9
North Carolina	70,552,737	13,171,681	8,351,346	62,201,391	744.8
South Carolina	356,771,757	68,696,424	18,426,763	338,344,994	1,836.2
Georgia	87,571,815	59,311,202	9,911,243	77,660,572	783.6
Florida	25,895,751	11,765,994	8,066,078	17,829,673	221.0
EAST SOUTH CENTRAL:					
Kentucky	75,593,179	37,232,623	27,835,614	47,757,565	171.6
Tennessee	75,544,893	34,847,956	24,472,632	51,072,261	208.7
Alabama	48,602,553	30,846,764	11,616,707	36,985,846	318.4
Mississippi	27,924,183	15,704,624	9,825,926	18,098,257	184.2
WEST SOUTH CENTRAL:					
Arkansas	17,786,660	11,519,316	9,965,997	7,820,663	78.5
Louisiana [2]	18,328,080	26,421,316	17,474,261	853,819	4.9
Oklahoma	48,824,097	24,985,903	3,825,763	44,998,334	1,176.2
Texas	149,008,819	75,829,108	48,888,450	100,120,369	204.8
MOUNTAIN:					
Montana	379,212,617	137,379,261	36,435,766	342,776,851	940.8
Idaho	115,812,292	9,577,588	5,018,149	110,794,143	130.8
Wyoming	11,580,567	5,499,084	3,883,285	7,697,282	198.2
Colorado	165,196,068	123,275,222	60,177,084	105,018,984	174.5
New Mexico	9,027,824	4,614,349	2,637,810	6,390,014	242.2
Arizona	32,960,084	9,392,302	3,662,045	29,298,039	800.0
Utah	86,634,658	61,672,661	32,457,063	54,177,595	166.9
Nevada	44,969,772	29,621,730	1,508,910	43,460,862	198.0
PACIFIC:					
Washington [2]	71,414,473	257,785,236	19,722,262	51,692,211	262.1
Oregon [2]	58,789,342	92,807,992	17,531,660	41,257,682	235.3
California	1,747,459,041	661,606,309	152,728,042	1,594,730,999	1,044.2

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[1] The decrease from 1907 to 1912 is due to the fact that one of the largest companies in Maryland, which generated the current used in 1907, purchased from outside the state most of that used in 1912.

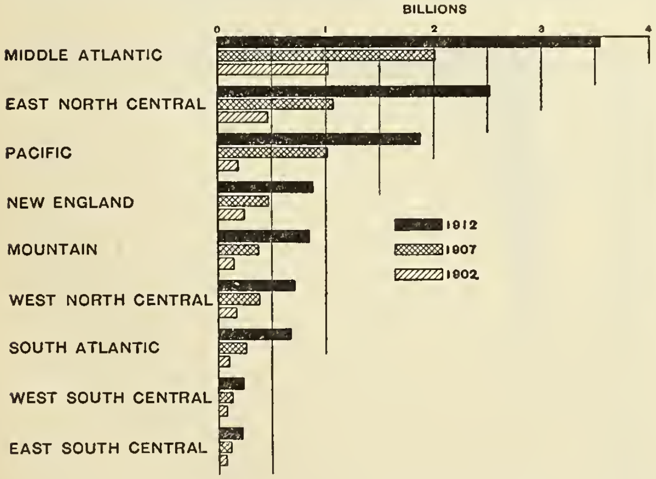
[2] The decrease from 1907 to 1912 is due to the fact that companies which were included among the central stations in 1907 have since that date been taken over by the railways and included with them in the report for the electric railway industry in 1912.

Comparing the output of central stations for 1912 with that for 1902, there was an increase of 9,025,911,891 kilowatt hours, or 360 per cent, in the amount of electricity produced annually.

The proportions of the total output reported for the different geographic divisions show considerable variation at the several censuses. The percentages of the total output for five of the divisions were less in 1912 than in 1902, as follows: The proportion for the New England division decreased from 9.9 per cent in 1902 to 7.6 per cent in 1912; the Middle Atlantic, from 40.7 to 30.8; the West North Central, from 6.8 to 6.2; the East South Central, from 2.9 to 2; and the West South Central, from 3.2 to 2 per cent. On the other hand, the proportions for the remaining divisions increased during the decade—that for the East North Central, from 19 per cent in 1902 to 21.9 per cent in 1912; the South Atlantic, from 4.1 to 5.9; the Mountain, from 5.8 to 7.3; and the Pacific, from 7.6 to 16.3, the increase for this division being little short of phenomenal.

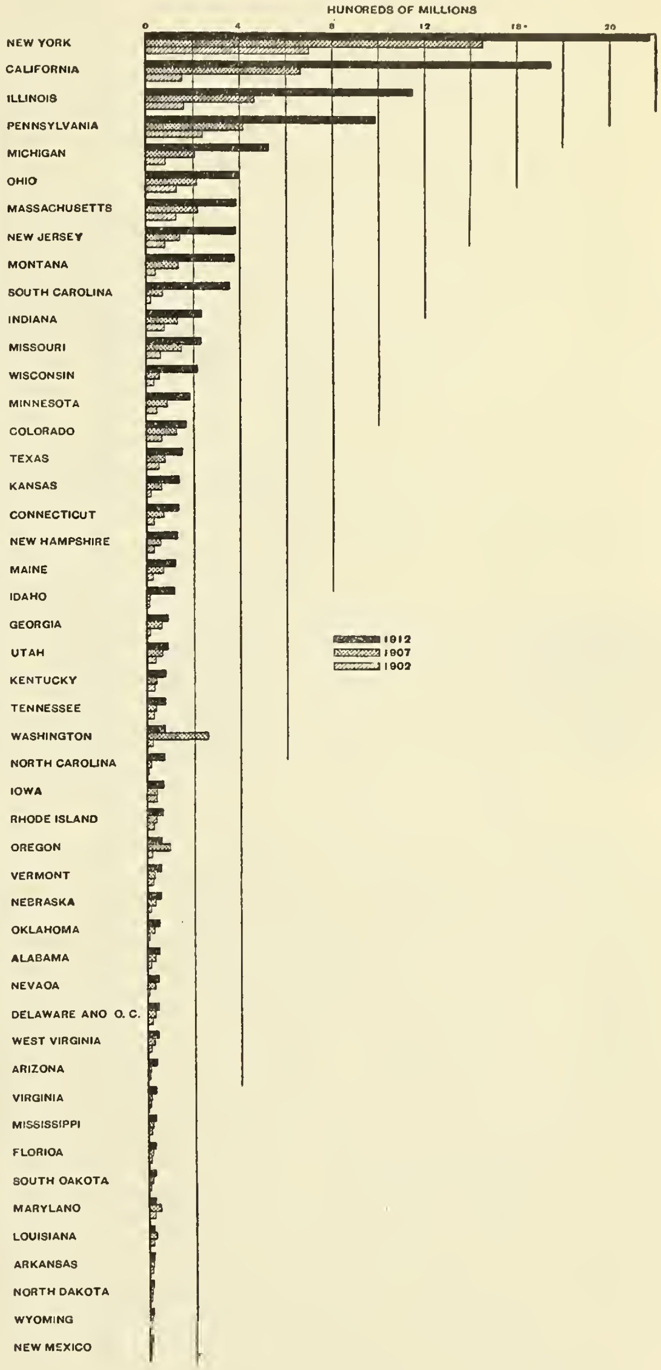
Of the total actual increase, the Middle Atlantic division reported 2,527,001,805 kilowatt hours, or 28 per cent; the East North Central division 2,052,866,187 kilowatt hours, or 22.7 per cent; and the Pacific division 1,687,680,892 kilowatt hours, or 18.7 per cent; these three divisions combined reporting an actual increase during the decade of 6,267,548,884 kilowatt hours, or 69.4 per cent of the total. The smallest proportion of the actual increase from 1902 to 1912 is shown for the West South Central division, with 153,793,185 kilowatt hours, or 1.7 per cent of the total.

Diagram 12.—Central Electric Stations—Kilowatt-Hour Output, by Geographic Divisions: 1912, 1907, and 1902.



Exceptionally large proportions of increase in the output of stations during the decade 1902–1912 are shown for South Carolina, Oklahoma, California, Montana, Kansas, Arizona, Georgia, and North Carolina, in the order named. The totals shown in the table for these states are eloquent as indicating the growth therein of the electrical industries.

Diagram 13.—Central Electric Stations—Kilowatt-Hour Output, by States: 1912, 1907, and 1902.



The presentation of state totals of output of the central electric stations would be the best indication of the growth in the central station industry were it not for the fact, previously referred to, that central electric stations at one census may at another census be combined and reported with electric railways to an extent which might impair the comparative value of such figures. A noticeable instance of this kind took place in Washington, for which state the output was 257,785,236 kilowatt hours in 1907 and only 71,414,473 in 1912. Precisely the same conditions existed in Louisiana and Delaware, for which states there was a decrease in the output between 1907 and 1912. Another decrease from 1907 to 1912 is shown for Maryland. In this latter instance, however, the decreased output was due to the fact that one of the largest stations in the state, which in 1907 generated the current consumed, in 1912 purchased it from a station located in Pennsylvania.

Purchased current.—Not until the census of 1912 did the schedule used by the Census Office call for the amount of electric current purchased, and statistics of this character, therefore, are confined to that year. In a very few instances some of the current purchased was generated in Canada, the most notable case being that for a company in New York state which reported the purchase of a large amount of current generated in that country.

Table 31 gives for central electric stations and electric railways the number of kilowatt hours of purchased current, the amount paid for such current, and the average cost per kilowatt hour, by geographic divisions, for 1912.

CENTRAL ELECTRIC STATIONS AND ELECTRIC RAILWAYS—PURCHASED CURRENT, KILOWATT HOURS, AND AMOUNT PAID FOR PURCHASED CURRENT, BY GEOGRAPHIC DIVISIONS: 1912.

Table 31	TOTAL.			CENTRAL ELECTRIC STATIONS.			ELECTRIC RAILWAYS.		
DIVISION.[1]	Purchased current, kilowatt hours.	Amount paid for purchased current.	Average cost per kilowatt hour (cents).	Purchased current, kilowatt hours.	Amount paid for purchased current.	Average cost per kilowatt hour (cents).	Purchased current, kilowatt hours.	Amount paid for purchased current.[2]	Average cost per kilowatt hour (cents).
United States	5,580,821,386	$42,620,874	0.8	2,613,502,605	$18,074,344	0.7	2,967,318,781	$24,546,530	0.8
New England	232,382,012	2,818,501	1.2	136,821,236	1,394,330	1.0	95,560,776	1,424,171	1.5
Middle Atlantic	1,884,722,386	13,778,379	0.7	989,404,314	5,982,590	0.6	895,318,072	7,795,789	0.9
East North Central	1,073,512,511	9,584,184	0.9	276,742,512	2,933,041	1.0	796,769,999	6,651,143	0.8
West North Central	383,167,448	3,945,449	1.0	183,535,438	2,135,944	1.1	199,632,010	1,809,505	0.9
South Atlantic	656,623,987	3,207,015	0.5	407,716,658	1,831,265	0.4	248,907,329	1,375,750	0.5
East South Central	57,811,414	507,933	0.9	15,948,772	131,697	0.8	41,862,642	376,236	0.9
West South Central	92,487,788	952,253	1.0	38,763,468	311,664	0.8	53,724,320	640,589	1.2
Mountain	259,796,097	1,590,136	0.6	188,201,530	1,032,516	0.5	71,594,567	557,620	0.8
Pacific	940,317,743	6,237,024	0.7	376,368,677	2,321,297	0.6	563,949,066	3,915,727	0.7

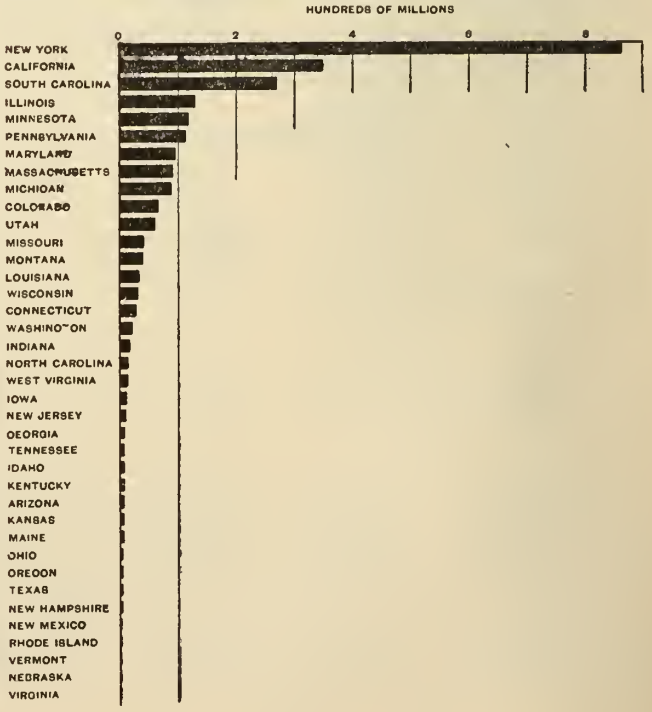
[1] See page 25 for states composing the several geographic divisions.

[2] Includes a small amount paid for power other than electric.

In considering the amounts paid per kilowatt hour for current in the different geographical divisions, several conditions should be borne in mind. The rate for any given section is often greatly influenced by the interchange of current between two divisions of the same company, as from the lighting division to the railway division, or vice versa. Again, the output of many large generating plants is sold at the switchboard to distributing companies organized for sales purposes. In such instances the price per kilowatt may be less than the prevailing price for current in the same locality. Notwithstanding these conditions, there is a close harmony between the cost figures for central stations and those for electric railways in the same geographic divisions. In this connection it might be well to mention that the construction of large generating stations makes the purchasing of current more economical and hence more general for a considerable number of the smaller stations that originally were equipped with generating machinery.

The lowest average cost per kilowatt hour, namely, four-tenths of 1 cent, was reported by the electric stations in the South Atlantic group of states, and the electric railways in the same division reported the lowest average cost for electric railways, five-tenths of 1 cent. The highest average cost per kilowatt hour for the central electric stations was reported by the states of the West North Central division, $1\frac{1}{10}$ cents, and the highest average cost shown for railways was in the New England group, $1\frac{5}{10}$ cents. The latter geographic division also shows the highest average cost per kilowatt hour, 12 mills, for both classes of stations combined.

DIAGRAM 14.—CENTRAL ELECTRIC STATIONS—PURCHASED CURRENT, KILOWATT HOURS, BY STATES: 1912.



Central stations and electric railways combined.—Previous tables have shown separately the primary power, the dynamo capacity, and the output of stations for central electric stations and electric railways combined, for the United States, but it is deemed important that these totals, which so largely represent the generating equipment of the two industries combined, be brought together in a single table and presented for the different states and geographic divisions. Table 32, therefore, gives for central stations and electric railways combined the primary power equipment, kilowatt capacity of dynamos, and output of stations, by geographic divisions and states, for 1912 and 1907.

Of the several geographic divisions, the three which showed the greatest actual increase in primary power are as follows: Middle Atlantic, 1,063,906 horsepower, or 55.2 per cent; East North Central, 1,041,757 horsepower, or 70.7 per cent; and Pacific, 696,261 horsepower, or 102 per cent. In dynamo capacity the East North Central division led in actual increase, with 779,949 kilowatts, or 79. 9 per cent, followed by the Middle Atlantic, with 709,086 kilowatts, or 53 per cent, and the Pacific, with 483,283 kilowatts, or 117.7 per cent.

In the output of stations the ranking order of these three divisions in actual increase was Middle Atlantic, East North Central, and Pacific. The rates of increase for these divisions were 46 per cent, 70.5 per cent, and 117.3 per cent, respectively.

During the five-year period 1907–1912 New York, California, Illinois, and Pennsylvania, in the order named, showed the largest actual increase in total primary horsepower and in the capacity of dynamos, but for these states the percentage of increase was greatest for California. For New York the increase in primary power was 673,725 horsepower, or 59.1 per cent, and for California it was 435,571 horsepower, or 97.7 per cent. In dynamo capacity New York increased 422,890 kilowatts, or 53.3 per cent, and California 329,868 kilowatts, or 116.6 per cent. Of these four states, in the output of stations, California leads in the actual increase, 985,255,952 kilowatt hours, and also in the per cent of increase, 127.4. In actual increase of output New York, Pennsylvania, and Illinois follow in the order named, but for the rate of increase the order is changed somewhat, as follows: Pennsylvania, with 68.1 per cent; Illinois, with 64.2 per cent; and New York, with 39.4 per cent.

A number of states show percentages of increase during the five-year period that are greater than those shown for the four states named, but the totals for these states are comparatively small. The states embraced in the Mountain division may be mentioned as an illustration.

COMPARATIVE SUMMARY—CENTRAL ELECTRIC STATIONS AND ELECTRIC RAILWAYS—PRIMARY POWER, DYNAMO CAPACITY, AND OUTPUT OF STATIONS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912 AND 1907.

Table 32

DIVISION AND STATE.	Census.	PRIMARY POWER.							KILOWATT CAPACITY OF DYNAMOS.			Total output of stations, kilowatt hours.
		Total horsepower.	Steam engines and steam turbines.		Gas and oil engines.		Water wheels.		Total.	Direct current.	Alternating current.	
			Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.				
UNITED STATES	1912	11,193,699	10,108	8,116,086	1,164	135,225	3,316	2,942,388	7,642,755	1,243,365	6,399,390	17,585,662,014
	1907	6,618,011	11,422	5,104,800	504	72,163	2,709	1,441,048	4,432,641	1,428,954	3,003,687	10,621,406,837
GEOGRAPHIC DIVISIONS:												
New England	1912	1,157,132	885	903,604	55	10,017	563	243,511	820,628	210,017	610,611	1,555,814,478
	1907	718,499	1,126	566,829	39	6,823	520	144,847	501,427	240,673	260,754	1,015,385,019
Middle Atlantic	1912	2,991,020	1,961	2,291,573	192	33,939	595	665,508	2,047,134	340,876	1,706,258	5,371,253,169
	1907	1,927,114	2,478	1,561,260	118	17,137	532	348,717	1,338,048	449,593	888,455	3,679,460,449
East North Central	1912	2,515,706	2,627	2,183,091	224	26,710	703	305,905	1,756,368	342,488	1,413,880	3,995,158,144
	1907	1,473,949	3,137	1,318,501	123	12,725	610	142,723	976,419	371,929	604,490	2,343,163,832
West North Central	1912	929,220	1,513	766,922	424	29,578	272	132,720	641,343	113,222	528,121	1,209,359,546
	1907	577,054	1,538	468,027	97	7,336	200	101,691	379,206	113,895	265,311	786,641,429
South Atlantic	1912	1,004,038	945	587,888	60	11,373	385	404,777	682,325	79,616	602,709	1,074,027,912
	1907	552,496	950	374,427	31	6,520	266	171,549	367,195	89,764	277,431	643,771,881
East South Central	1912	354,338	616	315,628	13	1,080	47	37,630	241,347	48,286	193,061	476,150,487
	1907	218,799	603	210,492	3	60	29	8,247	147,736	43,924	103,812	298,426,946
West South Central	1912	344,799	890	318,767	153	17,354	35	8,678	242,617	48,608	194,009	425,302,675
	1907	206,039	813	199,287	59	3,690	24	3,062	136,856	51,604	85,252	258,425,302
Mountain	1912	518,721	306	179,637	20	2,695	313	336,389	317,176	17,089	300,087	980,641,612
	1907	261,597	337	112,244	13	855	231	148,498	175,220	22,677	152,543	446,471,639
Pacific	1912	1,378,725	365	568,976	23	2,479	403	807,270	893,817	43,163	850,654	2,497,953,991
	1907	682,464	440	293,733	21	17,017	297	371,714	410,534	44,895	365,639	1,149,660,340
NEW ENGLAND:												
Maine	1912	129,773	89	34,136	3	135	199	95,502	89,991	17,387	72,604	171,241,221
	1907	78,225	115	31,459	...	...	164	46,766	52,947	14,755	38,192	95,270,975
New Hampshire	1912	88,330	64	27,306	11	1,905	117	59,119	60,503	4,796	55,707	131,950,020
	1907	50,414	70	23,095	8	1,115	103	26,204	34,637	6,112	28,525	58,209,739
Vermont	1912	58,018	54	17,996	2	95	111	39,927	36,212	3,372	32,840	63,420,652
	1907	44,016	50	12,589	4	205	107	31,222	26,729	4,776	21,953	34,056,513
Massachusetts	1912	623,576	467	591,515	27	5,872	70	26,189	450,236	136,786	313,450	838,789,192
	1907	387,422	620	365,216	17	3,797	73	18,409	275,116	154,537	120,579	589,133,532
Rhode Island	1912	95,349	37	91,784	5	1,125	13	2,440	70,109	13,959	56,150	124,222,051
	1907	57,071	70	53,808	4	1,000	16	2,263	41,840	23,681	18,159	93,410,987
Connecticut	1912	162,086	174	140,867	7	885	53	20,334	113,577	33,717	79,860	226,191,342
	1907	101,351	201	80,662	6	706	57	19,983	70,158	36,812	33,346	145,303,273
MIDDLE ATLANTIC:												
New York	1912	1,813,529	781	1,273,422	76	9,186	436	530,921	1,216,336	140,143	1,076,193	3,374,059,343
	1907	1,139,804	912	819,079	32	5,290	386	315,435	793,446	226,994	566,452	2,420,974,919
New Jersey	1912	268,612	296	264,683	21	2,360	18	1,569	203,209	49,560	153,649	417,089,681
	1907	185,537	335	182,415	11	1,328	22	1,794	137,298	48,866	88,432	318,320,064
Pennsylvania	1912	908,879	884	753,468	95	22,393	141	133,018	627,589	151,173	476,416	1,580,104,145
	1907	601,773	1,231	559,766	75	10,519	124	31,488	407,304	173,733	233,571	940,165,466
EAST NORTH CENTRAL:												
Ohio	1912	670,347	787	648,155	95	11,502	38	10,690	477,903	136,640	341,263	1,011,186,644
	1907	415,256	899	406,091	55	5,878	26	3,287	282,182	126,946	155,236	667,104,385
Indiana	1912	307,423	446	281,468	19	2,040	90	23,915	228,748	26,610	202,138	454,911,393
	1907	196,967	507	176,066	15	1,295	83	19,606	136,666	35,890	100,776	274,795,437
Illinois	1912	820,411	691	774,807	35	3,042	105	42,562	576,288	112,163	464,125	1,549,487,964
	1907	497,492	974	484,991	19	870	86	11,631	334,045	138,379	195,666	943,581,414
Michigan	1912	445,462	389	309,382	27	1,626	262	134,454	291,535	31,811	259,724	649,339,814
	1907	241,052	440	154,711	11	603	249	85,738	139,638	37,428	102,210	318,743,484
Wisconsin	1912	272,063	314	169,279	48	8,500	208	94,284	181,894	35,264	146,630	330,232,329
	1907	123,182	317	96,642	23	4,079	166	22,461	83,888	33,286	50,602	138,939,112
WEST NORTH CENTRAL:												
Minnesota	1912	261,694	262	154,767	54	4,755	124	102,172	173,070	17,922	155,148	275,281,155
	1907	173,055	267	89,691	22	1,428	83	81,936	113,434	18,672	94,762	189,029,616
Iowa	1912	133,593	374	123,906	52	2,658	58	7,029	96,210	28,172	68,038	150,640,398
	1907	79,089	369	74,692	11	564	44	3,833	56,078	27,379	28,699	79,979,727
Missouri	1912	308,035	371	303,661	22	2,472	5	1,902	214,931	42,199	172,732	500,619,707
	1907	202,938	452	199,973	13	963	5	2,002	129,572	41,713	87,859	375,903,548
North Dakota	1912	16,249	75	15,931	8	318	...	...	11,024	4,807	6,217	12,334,553
	1907	10,527	61	10,222	2	205	1	100	6,093	4,063	2,030	8,261,885
South Dakota	1912	27,748	50	16,003	86	4,832	15	6,913	20,032	2,492	17,540	24,703,754
	1907	12,984	52	10,251	10	528	12	2,205	10,046	1,488	8,558	13,615,015
Nebraska	1912	71,293	168	61,577	91	3,832	44	5,884	48,011	8,985	39,026	95,169,030
	1907	42,102	154	38,303	17	845	19	2,954	28,041	9,655	18,386	52,026,421
Kansas	1912	110,608	213	91,077	111	10,711	26	8,820	78,065	8,645	69,420	150,610,949
	1907	56,359	183	44,895	22	2,803	36	8,661	35,942	10,925	25,017	67,825,217

COMPARATIVE SUMMARY—CENTRAL ELECTRIC STATIONS AND ELECTRIC RAILWAYS—PRIMARY POWER, DYNAMO CAPACITY, AND OUTPUT OF STATIONS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912 AND 1907—Continued.

Table 32—Continued. DIVISION AND STATE.	Census.	PRIMARY POWER.							KILOWATT CAPACITY OF DYNAMOS.			Total output of stations, kilowatt hours.
		Total horse-power.	Steam engines and steam turbines.		Gas and oil engines.		Water wheels.		Total.	Direct current.	Alternating current.	
			Number.	Horse-power.	Number.	Horse-power.	Number.	Horse-power.				
SOUTH ATLANTIC:												
Delaware	1912	24,901	42	23,825	3	250	8	826	16,095	4,975	11,120	25,840,778
	1907	14,800	47	14,515	......	......	5	285	12,408	7,767	4,641	12,238,788
Maryland	1912	125,638	112	121,592	8	823	25	3,223	91,364	16,077	75,287	36,758,346
	1907	118,531	150	117,054	5	130	13	1,347	74,708	17,963	56,745	153,451,176
District of Columbia	1912	77,230	24	77,230	......	......	......	......	57,058	8,458	48,600	116,923,808
	1907	38,290	42	38,290	......	......	......	......	27,727	8,627	19,100	66,006,336
Virginia	1912	160,489	125	93.905	3	185	92	66,399	116,496	12,040	104,456	145,024.055
	1907	82,482	138	55,046	5	960	69	26,476	55,951	21,112	34.839	94,939,273
West Virginia	1912	68,925	132	59,804	24	3,085	14	6,036	49,767	11,980	37,787	102,198,976
	1907	42,891	118	37,989	12	1,275	11	3,627	31,294	9,869	21,425	64,729,936
North Carolina	1912	93,713	118	31,882	5	1,680	76	60,151	61.389	4.059	57,330	88,701,305
	1907	33,108	116	20,296	......	......	52	12.812	23,746	4,317	19.429	33,969,179
South Carolina	1912	230,606	84	51,596	3	455	88	178,555	140,986	4,878	136,108	365,575,958
	1907	103,731	86	20,111	1	150	58	83,470	64,663	3,373	61,290	96,312,449
Georgia	1912	170,832	195	84,625	5	3,720	71	82.487	112,841	9,976	102,865	142.082,277
	1907	93,380	155	48,108	2	3,140	50	42.132	60,438	11,494	48,944	94,637,017
Florida	1912	51,704	113	43,429	9	1,175	11	7.100	36,329	7,173	29,156	50,922,414
	1907	25,283	98	23,018	6	865	8	1,400	16,260	5,242	11,018	27,487,727
EAST SOUTH CENTRAL:												
Kentucky	1912	108,227	188	107,651	6	576	......	......	69,867	16.149	53,718	149,408,553
	1907	71,409	192	71,394	1	15	......	......	48.210	17,429	30,781	90,658,286
Tennessee	1912	122,361	164	94,166	4	445	32	27,750	85,690	15,213	70.477	157,305.115
	1907	68.385	165	67,145	......	......	14	1,240	46.718	11.922	34,796	98,498,291
Alabama	1912	83,403	122	73,504	2	19	15	9,880	57.277	13.967	43.310	131,557,661
	1907	52,619	114	45,592	1	20	15	7,007	36,024	11,542	24.482	78,954,853
Mississippi	1912	40,347	142	40,307	1	40	......	......	28,513	2.957	25.556	37,879,158
	1907	26,386	132	26,361	1	25	......	......	16,784	3.031	13.753	30,315,516
WEST SOUTH CENTRAL:												
Arkansas	1912	42,604	134	39,343	5	221	10	3,040	30,442	6.610	23.832	42,625,641
	1907	24.494	125	24.182	1	12	1	300	17,012	5,714	11.298	27,867,049
Louisiana	1912	70,910	118	69,920	9	990	......	......	52,059	21,372	30,687	104,591.816
	1907	66,723	171	66,303	3	420	......	......	41,678	23.865	17.813	93,441,254
Oklahoma	1912	63,597	204	55,196	39	6.266	7	2,135	45,931	4,895	41,036	65,217.869
	1907	24,423	117	24,223	2	200	......	......	16,999	3.420	13,579	26,993,403
Texas	1912	167,688	434	154,308	100	9,877	18	3,503	114.185	15,731	98,454	212,867,349
	1907	90,399	400	84.579	53	3,058	23	2,762	61,167	18,605	42,562	110,123,596
MOUNTAIN:												
Montana	1912	117,230	39	13,500	1	75	67	103.655	75,468	2,705	72,763	381,012,617
	1907	69,967	33	12,980	......	......	62	56,987	40.402	3,210	37.192	137,379,261
Idaho	1912	56,375	14	4,525	......	......	63	51,850	35,656	126	35,530	115,812,292
	1907	13,694	19	2,202	......	......	37	11.492	7,082	147	6,935	9.577,588
Wyoming	1912	11.596	45	10,162	1	100	11	1,334	8.212	1.077	7.135	11,580.567
	1907	5,125	34	4.360	......	......	6	765	3,208	1,003	2.205	5,499,084
Colorado	1912	182,536	122	100,251	1	80	72	82,205	101,360	10,241	91.119	263,111.504
	1907	104,217	164	76,457	4	300	52	27,460	66,764	14,104	52.660	165,385,828
New Mexico	1912	11,015	32	8,428	9	1,770	9	817	7,981	876	7,105	9,027,824
	1907	5,728	30	5,215	......	......	6	513	4,894	1,655	3,239	5,519,914
Arizona	1912	22,675	35	13,375	......	......	4	9,300	15,151	991	14,160	33,645,484
	1907	7,746	32	6,926	3	70	4	750	5,063	901	4,162	9,611,342
Utah	1912	101,874	13	27,186	......	......	74	74,688	62,835	735	62,100	121,481,552
	1907	48,140	21	3,869	......	......	55	44,271	42,117	1,597	40,520	83,876,892
Nevada	1912	15,420	6	2,210	8	670	13	12,540	10,513	338	10,175	44,969,772
	1907	6,980	4	235	6	485	9	6,260	5,690	60	5,630	29,621,730
PACIFIC:												
Washington	1912	341,701	83	71,895	3	165	107	269,641	209,913	10,808	199,105	510,822,535
	1907	109,661	114	48,553	2	90	51	61,018	94,987	12,869	82,118	283,302,190
Oregon	1912	155,465	72	49,829	9	334	88	105,302	71,156	5,249	65,907	228,398,346
	1907	126,815	66	24,581	6	182	72	102,052	32,667	3,957	28,710	92,880,992
California	1912	881,559	210	447,252	11	1,980	208	432,327	612,748	27,106	585,642	1,758,733,110
	1907	445,988	260	220,599	13	16,745	174	208,644	282,880	28,069	254,811	773,477,158

CHAPTER V.

LINE EQUIPMENT.

Central stations and electric railways.—In addition to the number of lamps, the line equipment covered by the statistics includes stationary motors and meters for recording the current consumed.

There are other equipment and features of line construction, such as miles of wire, miles of duct for underground work, and number of transformers. Statistics concerning these were collected at prior censuses, but were found to be so unreliable that such inquiries were omitted from the schedule for 1912.

The features of line equipment covered by the census of 1912 are given in Table 33, for central stations and electric railways, for 1912, 1907, and 1902.

CENTRAL ELECTRIC STATIONS AND STATIONS OPERATED IN CONNECTION WITH ELECTRIC RAILWAYS—LINE EQUIPMENT: 1912, 1907, AND 1902.

[The statistics for electric railways in the following table are for central electric stations operated in connection with electric railways for which complete separate reports could not be secured, hence the full statistics for them have been included with those for electric railways. The statistics shown for these stations represent only the electric light and power departments.]

Table 33	ESTIMATED NUMBER OF LAMPS WIRED FOR SERVICE.									STATIONARY MOTORS SERVED.		Number of meters on consumption circuits.
	Arc.			Incandescent.			Other varieties—Nernst, vapor, etc.					
	Total.	Public.	Commercial.	Total.	Public.	Commercial.	Total.	Public.	Commercial.	Number.	Horsepower.	
Total:												
1912	560,981	388,592	172,389	85,557,819	2,152,612	83,405,207	59,213	1,743	57,470	435,473	4,130,619	3,617,189
1907	635,815	318,819	316,996	45,991,836	866,851	45,124,985	190,979	6,090	184,889	187,652	1,807,949	1,897,803
1902	419,561	229,403	190,158	19,636,729	474,686	19,162,043	(1)	(1)	(1)	111,113	473,693	639,290
Central stations:												
1912	505,395	351,858	153,537	76,484,096	2,033,831	74,450,265	23,046	912	22,134	435,473	4,130,619	3,617,189
1907	555,713	289,391	266,322	41,445,997	808,693	40,637,304	162,338	5,716	156,622	167,184	1,649,026	1,683,917
1902	385,698	211,725	173,973	18,194,044	455,660	17,738,384	(1)	(1)	(1)	101,064	438,005	582,689
Electric railways:												
1912	55,586	36,734	18,852	9,073,723	118,781	8,954,942	36,167	831	35,336	(2)	(2)	(2)
1907	80,102	29,428	50,674	4,545,839	58,158	4,487,681	28,641	374	28,267	20,468	158,923	213,886
1902	33,863	17,678	16,185	1,442,685	19,026	1,423,659	(1)	(1)	(1)	10,049	35,688	56,601
	PER CENT OF INCREASE.[3]											
Total:												
1902 to 1912	33.7	69.4	−9.3	335.7	353.5	335.3	....	....	....	291.9	772.0	465.8
1907 to 1912	−11.8	21.9	−45.6	86.0	148.3	84.8	−69.0	−71.4	−68.9	132.1	128.5	90.6
1902 to 1907	51.5	39.0	66.7	134.2	82.6	135.5	....	....	....	68.9	281.7	196.9
Central stations:												
1902 to 1912	31.0	66.2	−11.7	320.4	346.3	319.7	....	....	....	330.9	843.1	520.8
1907 to 1912	−9.1	21.6	−42.3	84.5	151.5	83.2	−85.8	−84.0	−85.9	160.5	150.5	114.8
1902 to 1907	44.1	36.7	−53.1	127.8	77.5	129.1	....	....	....	65.4	276.5	189.0
Electric railways:												
1902 to 1912	64.1	107.8	16.5	528.9	524.3	529.0	....	....	....	....	....	....
1907 to 1912	−30.6	24.8	62.8	99.6	104.2	99.5	26.3	122.2	25.0	....	....	....
1902 to 1907	136.5	66.5	213.1	215.1	205.7	215.2	....	....	....	103.7	345.3	277.9

[1] Not reported separately.

[2] Not reported.

[3] A minus sign (−) denotes decrease.

The general use of meter service makes it no longer necessary for the companies to preserve a record of the number of lamps wired for use, therefore the number reported by each company is largely an estimate.

One of the most noticeable features in connection with the data concerning lamps is the decrease in the number of "all other varieties" and the general acceptance in the industry of two types—the incandescent and arc—as the standards for light service. Although the estimated number of arc lamps has increased during the decade, it is the incandescent lamp that has made the greatest gains. The total number of arc lamps increased from 419,561 in 1902 to 635,815 in 1907, but at the census of 1912 the number was only 560,981, a decrease during the latter five-year period of 74,834 arc lamps, or 11.8 per cent. In 1902 arc lamps wired for commercial purposes formed 45.3 per cent of the total number in service; in 1907 this percentage had risen to 49.9, but in 1912 it had dropped to 30.7. Although the arc light lost ground in commercial or private lighting, it made considerable gains in the public field, showing increases of 21.9 per cent for the census period of 1907 to 1912 and 69.4 per cent for the 10-year period 1902 to 1912. In striking contrast to the small gains and losses for the arc form of lighting were the great strides made by the incandescent system. The total estimated number of incandescent lamps wired for service was 45,991,836 in 1907 and 19,636,729 in 1902, a gain of 26,355,107, or 134.2 per cent, for the five-year period. From 1907 to 1912 there was a gain of 39,565,983, or 86 per cent, while that for the decade was 65,921,090, or 335.7 per cent. The percentage of increase was practically the same for both public and commercial lighting, 353.5 and 335.3, respectively. The invasion by the incandescent lamp of the public field, formerly so largely occupied by the arc, is particularly noteworthy, and is due principally to the improvements in the tungsten lamp. Notwithstanding the great advances made, this system of lighting is still in a transitory state, as evidenced by the many methods now being used to light the streets in various cities, in the effort to meet the continued demand for a high candlepower, diffusible, economical lamp suitable for open-air service.

Perhaps the best illustration of the revolution in incandescent lighting caused by the tungsten lamp is found in the following tabular statement showing the proportionate annual sales of different types of incandescent lamps from 1907 to 1912, inclusive, as reported at the Chicago session of the National Electric Light Association in June, 1913, by the lamp committee of the association.

TYPE.	1912	1911	1910	1909	1908	1907
Total	100.0	100.0	100.0	100.0	100.0	100.0
Carbon	25.47	52.90	63.08	68.98	84.12	93.27
Gem	33.59	19.00	14.88	15.07	8.58	5.88
Tantalum	1.00	2.74	3.57	2.12	1.78	0.75
Mazda	39.94	25.30	18.47	13.83	5.52	0.10

What has been said of the total for lamps in the United States is equally applicable to the two industries shown in the table. The central stations reported 92.6 per cent of the total number of lamps in 1902, 88.6 per cent in 1907, and 89.4 per cent in 1912. A general decrease in commercial arc lighting, a moderate increase in public arc lighting, and large gains in incandescent lighting for both public and commercial service represent the trend of events in the electric-lighting field for the five years from 1907 to 1912.

Of the different items of line equipment presented in the table, capacity of stationary motors shows the greatest percentage of gain during the decade 1902–1912, and meters were second in that respect for the same period.

Table 34 gives for commercial and municipal stations the numbers of lamps, stationary motors, meters, and customers for 1912, 1907, and 1902.

Of the total number of lamps of all types, the number of arc lamps formed but seven-tenths of 1 per cent in 1912 and 1.3 per cent in 1907, while in 1902 it formed 2.1 per cent. The enormous increase during the decade in the number of incandescent lamps and the small increase in the number of arc lamps account for this decreased proportion. In the commercial field for the decade there was a decrease in the number of arc lamps. While there have been improvements made in the form of arc lighting, much greater advances have been made in the incandescent lamp, which now lends itself to all forms of illumination without the care and attention which necessarily accompany the arc light. Notwithstanding the decrease in the number of arc lights reported by commercial companies from 1907 to 1912, during this period the number of arc lights furnished by municipal stations showed an increase of 10.7 per cent, as compared with 63.3 per cent for the five-year period 1902 to 1907.

COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—LINE EQUIPMENT: 1912, 1907, AND 1902.

Table 34 CLASS OF STATIONS.	ARC LAMPS.			INCANDESCENT LAMPS.			OTHER VARIETIES—NERNST, VAPOR, ETC.			STATIONARY MOTORS SERVED.		Number of meters on consumption circuits.	Number of customers.
	Total.	Public.	Commercial.	Total.	Public.	Commercial.	Total.	Public.	Commercial.	Number.	Horsepower.		
Total:													
1912	505,395	351,858	153,537	76,484,096	2,033,831	74,450,265	23,046	912	22,134	435,473	4,130,619	3,617,189	3,837,518
1907	555,713	289,391	266,322	41,445,997	808,693	40,637,304	162,338	5,716	156,622	167,184	1,649,026	1,683,917	1,946,979
1902	385,698	211,725	173,973	18,194,044	455,660	17,738,384	(1)	(1)	(1)	101,064	438,005	582,689	(2)
Commercial:													
1912	413,544	267,113	146,431	69,428,356	1,602,855	67,825,501	20,937	491	20,446	413,578	3,966,328	3,146,998	3,311,870
1907	472,773	216,309	256,464	37,393,549	638,456	36,755,093	153,468	4,584	148,884	162,677	1,617,337	1,468,763	1,663,354
1902	334,903	166,723	168,180	16,616,593	372,740	16,243,853	(1)	(1)	(1)	99,102	434,681	526,011	(2)
Municipal:													
1912	91,851	84,745	7,106	7,055,740	430,976	6,624,764	2,109	421	1,688	21,895	164,291	470,191	525,648
1907	82,940	73,082	9,858	4,052,448	170,237	3,882,211	8,870	1,132	7,738	4,507	31,689	215,154	283,625
1902	50,795	45,002	5,793	1,577,451	82,920	1,494,531	(1)	(1)	(1)	1,962	3,324	56,678	(2)
	PER CENT OF INCREASE.[3]												
Total:													
1902–1912	31.0	66.2	−11.7	320.4	346.3	319.7	....	....	....	330.9	843.1	520.8	....
1907–1912	−9.1	21.6	−42.3	84.5	151.5	83.2	−85.8	−84.0	−85.9	160.5	150.5	114.8	97.1
1902–1907	44.1	36.7	53.1	127.8	77.5	129.1	....	....	....	65.4	276.5	189.0	....
Commercial:													
1902–1912	23.5	60.2	−12.9	317.8	330.0	317.5	....	....	....	317.3	812.5	498.3	....
1907–1912	−12.5	23.5	−42.9	85.7	151.1	84.5	−36.4	−89.3	−37.3	154.2	145.2	114.3	99.1
1902–1907	41.2	29.7	52.5	125.0	71.3	126.3	....	....	....	64.2	272.1	179.2	....
Municipal:													
1902–1912	80.8	88.3	22.7	347.3	419.7	343.3	....	....	....	1,016.0	4,842.6	729.6	....
1907–1912	10.7	16.0	−27.9	74.1	153.2	70.6	−76.2	−62.8	−78.2	385.8	418.4	118.5	85.3
1902–1907	63.3	62.4	70.2	156.9	105.3	159.8	....	....	....	129.7	853.3	279.6	....

[1] Not reported separately.

[2] Not reported.

[3] A minus sign (−) denotes decrease.

The proportion of the total number of arc lamps reported by the commercial stations decreased from 86.8 per cent in 1902 to 85.1 per cent in 1907, and to 81.8 per cent in 1912, and the proportions of arc lights in public service reported by such stations were 75.9, 74.7, and 78.7 for the censuses of 1912, 1907, and 1902, respectively. Municipal plants reported less than 5 per cent of the number of arc lights in the commercial field in any of these census years.

The proportion of the total number of incandescent lamps reported by commercial and municipal companies was about the same for each census, the commercial stations furnishing slightly more than 90 per cent in each year.

There was an increase of over 4,800 per cent in the horsepower of stationary motors served by the municipal plants from 1902 to 1912. Notwithstanding this great percentage of increase, of the total amount of such power for all central stations in the latter year, that reported by the municipal stations was equal to only about 4 per cent. This was an increase, however, as compared with the proportions shown for prior censuses, which were 1.9 per cent in 1907 and eight-tenths of 1 per cent in 1902.

In Table 55 (p. 82) the line equipment of the central electric stations is shown for 1912 by geographic divisions and states. It appears from this table that two of the nine divisions, combined, the Middle Atlantic and East North Central, contributed a large proportion of this equipment, as follows: Of arc lamps, 63.2 per cent; incandescent lamps, 53.2 per cent; horsepower of stationary motors, 48.7 per cent; and meters on consumption circuits, 49.3 per cent. These two divisions reported 46.8 per cent of the total number of customers. New York was the leading state in all these items, as it is in population and manufactures.

The increases in the line equipment of commercial and municipal central electric stations are presented in another form in Table 35. This table gives the average per station for number of arc and incandescent lamps, the average number of meters on consumption circuits, and the average number of stationary motors, together with the average horsepower per station and per machine for stationary motors for 1912, 1907, and 1902.

For both the commercial and municipal stations there was an increase in the average number of arc lamps per station in 1907, as compared with that in 1902, but a decided decrease when the averages for 1912 are compared with those for 1907; in fact, the average for 1912 was less than that for 1902. In direct contrast to this condition, there was an increased average number of incandescent lamps per station shown for each succeeding census, the larger gain in the average for this type of lamp having taken place during the period of loss for arc lamps—that is, the period 1907 to 1912.

The average number of meters per station has practically doubled, as shown by both commercial and municipal stations, at each succeeding census, and the average number of stationary motors per station shows even greater rates of increase.

The increasing popularity of electric power is shown by the great increase in the motor load connected to each station. In 1902 the average horsepower per station was 121; in 1907 it was 350; while in 1912 it had jumped to 791 horsepower, equivalent to a gain of 126 per cent in the average for 1912 over that for 1907.

Table 35

COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—LINE EQUIPMENT, AVERAGE PER STATION: 1912, 1907, AND 1902.

	Census.	Total.	Commercial.	Municipal.
Arc lamps:				
Average number per station	1912	97	113	59
	1907	118	137	66
	1902	107	119	62
Incandescent lamps:				
Average number per station	1912	14,649	18,975	4,517
	1907	8,792	10,801	3,237
	1902	5,026	5,924	1,936
Meters on consumption circuits:				
Average number per station	1912	693	860	301
	1907	357	424	172
	1902	161	188	70
Stationary motors:				
Average number per station	1912	83	113	14
	1907	35	47	4
	1902	28	35	2
Average horsepower per station	1912	791	1,084	105
	1907	350	467	25
	1902	121	155	4
Average horsepower per machine	1912	9.5	9.6	7.5
	1907	9.9	9.9	7.0
	1902	4.3	4.4	1.7

Street lamps.—In 1912, for the first time, the census schedule contained inquiries as to the number of arc and incandescent lamps used for street lighting. Notwithstanding the advances made in lighting streets by electricity, the problem is still receiving careful consideration from both commercial and municipal stations, on account of the interdependence of the economics and the physics of illuminating engineering. The complexity of the subject may be understood when consideration is given to the number of factors involved, such as the character of buildings facing the street, the materials and conditions of sidewalks and streets, the presence of trees or other obstructions and even psychological conditions.

Because of their characteristics, arc lamps were at first used to the exclusion of all others for outdoor service, and the improvement in this form of light from the original open arc to the inclosed luminous arc and to the flaming arc has been remarkable and has caused this light to continue the predominant one in street service. The wonderful advances in tungsten incandescent lamps, however, have made them a new and important feature in outdoor illumination. The great flexibility of this style of lighting renders it specially valuable and economical where lighting by arc lamps would be impossible or impracticable.

Many of the municipalities operating their own plants, and some of the smaller commercial stations, have a greater proportion of arc than of incandescent lamps in street service.

In addition to the two types of lamps shown, 23,046 lamps of other varieties were reported as used for all purposes. These have been disregarded in preparing Table 36.

In order to make a comprehensive presentation of the lamps used for street lighting in 1912, there are shown in Table 36 the numbers of arc and incandescent lamps used for this purpose by the commercial and municipal stations, by geographic divisions and states, and also the proportions which commercial and municipal form, respectively, of all arc and all incandescent lamps used for street service.

COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—NUMBER OF LAMPS USED FOR STREET LIGHTING, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

Table 36	ARC LAMPS.				INCANDESCENT LAMPS.[1]				PER CENT DISTRIBUTION OF EACH CLASS OF STREET LAMPS.			
		Street lamps.				Street lamps.			Arc.		Incandescent.	
DIVISION AND STATE.	Total for all purposes.	Total.	Reported by— Commercial stations.	Reported by— Municipal stations.	Total for all purposes.	Total.	Reported by— Commercial stations.	Reported by— Municipal stations.	Commercial.	Municipal.	Commercial.	Municipal.
UNITED STATES	505,395	348,643	264,152	84,491	76,484,096	681,379	474,048	207,331	75.8	24.2	69.6	30.4
GEOGRAPHIC DIVISIONS:												
New England	44,682	29,633	26,798	2,835	7,955,766	124,142	96,665	27,477	90.4	9.6	77.9	22.1
Middle Atlantic	181,582	109,039	100,889	8,150	22,096,036	125,044	116,765	8,279	92.5	7.5	93.4	6.6
East North Central	138,042	106,688	57,954	48,734	18,590,902	114,419	55,216	59,203	54.3	45.7	48.3	51.7
West North Central	40,860	24,751	18,073	6,678	8,327,120	102,152	59,734	42,418	73.0	27.0	58.5	41.5
South Atlantic	21,389	17,679	9,812	7,867	3,886,979	44,142	27,579	16,563	55.5	44.5	62.5	37.5
East South Central	18,365	15,247	10,766	4,481	2,147,154	18,816	9,755	9,061	70.6	29.4	51.8	48.2
West South Central	19,645	14,326	11,078	3,248	3,285,680	27,083	18,445	8,638	77.3	22.7	68.1	31.9
Mountain	9,926	8,150	7,879	271	2,239,281	23,317	17,532	5,785	96.7	3.3	75.2	24.8
Pacific	30,904	23,130	20,903	2,227	7,955,178	102,264	72,357	29,907	90.4	9.6	70.8	29.2
NEW ENGLAND:												
Maine	1,863	1,411	1,094	317	481,656	9,839	7,790	2.049	77.5	22.5	79.2	20.8
New Hampshire	1,900	1,482	1,482	....	397,487	9,100	8,584	516	100.0	....	94.3	5.7
Vermont	1,080	1,013	709	304	404,049	5,563	3,787	1,776	70.0	30.0	68.1	31.9
Massachusetts	28,238	17,601	15,834	1,767	4,686,834	67,372	53,124	14,248	90.0	10.0	78.9	21.1
Rhode Island	4,419	3,058	2,993	65	640,769	10,640	10,631	9	97.9	2.1	99.9	0.1
Connecticut	7,182	5,068	4,686	382	1,344,971	21,628	12,749	8,879	92.5	7.5	58.9	41.1
MIDDLE ATLANTIC:												
New York	94,324	47,391	44,403	2,988	12,884,436	62,706	58,793	3,913	93.7	6.3	93.8	6.2
New Jersey	22,585	16,052	15,561	491	2,961,254	33,708	32,298	1,410	96.9	3.1	95.8	4.2
Pennsylvania	64,673	45,596	40,925	4,671	6,250,346	28,630	25,674	2,956	89.8	10.2	89.7	10.3
EAST NORTH CENTRAL:												
Ohio	36,318	30,893	21,234	9,659	3,454,142	20,168	6,888	13,280	68.7	31.3	34.2	65.8
Indiana	17,328	14,989	10,077	4,912	2,375,533	19,873	9,550	10,323	67.2	32.8	48.1	51.9
Illinois	53,486	35,399	13,586	21,813	7,375,038	41,065	20,835	20,230	38.4	61.6	50.7	49.3
Michigan	20,516	16,220	5,310	10,910	3,601,427	22,425	11,688	10,737	32.7	67.3	52.1	47.9
Wisconsin	10,394	9,187	7,747	1,440	1,784,762	10,888	6,255	4,633	84.3	15.7	57.4	42.6
WEST NORTH CENTRAL:												
Minnesota	9,201	6,495	5,239	1,256	1,857,876	21,776	13,584	8,192	80.7	19.3	62.4	37.6
Iowa	4,679	3,637	3,066	571	1,512,552	27,479	17,784	9,695	84.3	15.7	64.7	35.3
Missouri	13,394	6,687	4,785	1,902	2,526,515	16,719	8,603	8,116	71.6	28.4	51.5	48.5
North Dakota	866	644	385	259	219,451	5,074	3,320	1,754	59.8	40.2	65.4	34.6
South Dakota	1,134	904	627	277	278,042	4,382	3,246	1,136	69.4	30.6	74.1	25.9
Nebraska	3,682	2,451	1,910	541	1,034,661	12,149	5,883	6,266	77.9	22.1	48.4	51.6
Kansas	7,904	3,933	2,061	1,872	898,023	14,573	7,314	7,259	52.4	47.6	50.2	49.8
SOUTH ATLANTIC:												
Delaware	131	91	86	5	41,959	1,507	850	657	94.5	5.5	56.4	43.6
Maryland	6,047	4,147	3,474	673	1,025,961	9,276	7,508	1,768	83.8	16.2	80.9	19.1
District of Columbia	1,966	1,166	1,166	....	658,899	5,626	5,626	....	100.0	....	100.0	....
Virginia	2,589	2,513	652	1,861	237,079	4,369	2,098	2,271	25.9	74.1	48.0	52.0
West Virginia	2,468	2,096	1,313	783	305,312	2,922	2,826	96	62.6	37.4	96.7	3.3
North Carolina	1,928	1,887	835	1,052	571,380	5,532	2,045	3,487	44.3	55.7	37.0	63.0
South Carolina	2,345	2,196	1,399	797	268,720	2,875	1,380	1,495	63.7	36.3	48.0	52.0
Georgia	2,651	2,370	660	1,710	410,068	7,283	1,848	5,435	27.8	72.2	25.4	74.6
Florida	1,264	1,213	227	986	367,601	4,752	3,398	1,354	18.7	81.3	71.5	28.5
EAST SOUTH CENTRAL:												
Kentucky	7,814	7,332	6,263	1,069	849,194	5,278	3,896	1,382	85.4	14.6	73.8	26.2
Tennessee	4,808	3,938	1,888	2,050	670,870	6,732	3,172	3,560	47.9	52.1	47.1	52.9
Alabama	3,920	2,314	1,652	662	347,871	2,805	1,135	1,670	71.4	28.6	40.5	59.5
Mississippi	1,823	1,663	963	700	279,219	4,001	1,552	2,449	57.9	42.1	38.8	61.2
WEST SOUTH CENTRAL:												
Arkansas	1,102	1,045	373	672	243,725	4,731	2,837	1,894	35.7	64.3	60.0	40.0
Louisiana	7,267	4,474	4,156	318	584,015	4,451	2,592	1,859	92.9	7.1	58.2	41.8
Oklahoma	3,659	3,303	2,642	661	592,311	8,334	4,699	3,635	80.0	20.0	56.4	43.6
Texas	7,617	5,504	3,907	1,597	1,865,629	9,567	8,317	1,250	71.0	29.0	86.9	13.1
MOUNTAIN:												
Montana	2,193	1,560	1,547	13	388,718	2,791	2,040	751	99.2	0.8	73.1	26.9
Idaho	1,349	1,109	1,024	85	261,092	3,886	2,535	1,351	92.3	7.7	65.2	34.8
Wyoming	492	396	376	20	112,226	1,168	1,059	109	94.9	5.1	90.7	9.3
Colorado	4,175	3,859	3,783	76	1,032,845	7,872	7,073	799	98.0	2.0	89.9	10.1
New Mexico	377	247	229	18	112,187	627	533	94	92.7	7.3	85.0	15.0
Arizona	686	454	454	....	136,390	1,335	1,335	....	100.0	....	100.0	....
Utah	333	321	262	59	150,380	5,237	2,706	2,531	81.6	18.4	51.7	48.3
Nevada	321	204	204	....	45,443	401	251	150	100.0	....	62.6	37.4
PACIFIC:												
Washington	4,729	2,661	1,016	1,645	779,787	20,223	4,986	15,237	38.2	61.8	24.7	75.3
Oregon	1,285	1,128	1,068	60	382,196	6,239	4,721	1,518	94.7	5.3	75.7	24.3
California	24,890	19,341	18,819	522	6,793,195	75,802	62,650	13,152	97.3	2.7	82.6	17.4

[1] Exclusive of 23,046 lamps of other varieties, 578 of which were used for street lighting.

Of the total number of arc lamps used for street lighting, 75.8 per cent were reported by commercial stations and 24.2 per cent by municipalities. In incandescent street lighting 69.6 per cent of the lamps were reported by commercial stations and 30.4 per cent by municipal stations.

In the Mountain division the commercial stations furnished practically all (96.7 per cent) of the arc lights used for street lighting, a larger proportion than is shown for any other group of states. In the Middle Atlantic states 92.5 per cent of the arc lights used for street lighting were reported by the commercial companies, and this class of stations in the New England and Pacific states reported the next largest proportion, 90.4 per cent in each case.

In four widely separated states—Arizona, Nevada, New Hampshire, and the District of Columbia—all of the street lighting by arc lamps was done by commercial companies. In the District of Columbia, Arizona, New Hampshire, Rhode Island, New York, New Jersey, West Virginia, and Wyoming over 90 per cent of the incandescent lamps for street lighting were furnished by commercial companies; and in the District of Columbia and Arizona all of the public street lighting, both arc and incandescent, was done by such companies.

Street lighting by municipal stations was of exceptional importance in Georgia, for which state these stations reported 72.2 per cent of the arc lamps used for such purposes and 74.6 per cent of the incandescents. Virginia and North Carolina, of the same geographic division, Washington, and several states in the East North Central division show large percentages of lamps for street lighting by municipal stations, but none that equal that for Georgia.

Stationary motor service.—As a source of income and as a consumer of current the stationary motor is second only to the lamp. The adaptability of the electric motor to all sizes of power units, the ease and small cost of installation, the economy of space required, its cleanliness, its instantaneous availability, the absence of noise, and the ease of operation make it superior to all other forms of motors or engines, except where conditions preclude its installation.

The growth in the use of stationary motors driven by current received from central electric stations is shown in Table 37, which gives the number and horsepower of stationary motors, by geographic divisions, for 1912, 1907, and 1902.

The increasing popularity of electricity as a motive power is shown by the comparative figures reported for the number and horsepower of stationary motors. The total number of stationary motors reported for central stations increased from 101,064 in 1902 to 167,184 in 1907 and to 435,473 in 1912, a gain for the two five-year periods equivalent to 65.4 per cent and 160.5 per cent, respectively. The increase in the horsepower was even greater, being 276.5 per cent from 1902 to 1907 and 150.5 per cent from 1907 to 1912. During the decade the total horsepower of these motors increased by 3,692,614, or 843.1 per cent, and their number by 334,409, or 330.9 per cent. The average horsepower per motor, which in 1902 was 4.3, had increased to 9.5 in 1912. The average capacity of motors was largest for the Pacific and Mountain divisions, 19.71 and 19.44 horsepower, respectively.

CENTRAL ELECTRIC STATIONS—NUMBER AND HORSEPOWER CAPACITY OF STATIONARY MOTORS: 1912, 1907, AND 1902.

Table 37 DIVISION.[1]	1912		1907		1902		AVERAGE CAPACITY.			PER CENT OF INCREASE IN HORSEPOWER.			PER CENT OF TOTAL HORSEPOWER.		
	Number.	Horse-power.	Number.	Horse-power.	Number.	Horse-power.	1912	1907	1902	1902–1912	1907–1912	1902–1907	1912	1907	1902
United States	435,473	4,130,619	167,184	1,649,026	101,064	438,005	9.49	9.86	4.33	843.1	150.5	276.5	100.0	100.0	100.0
New England	55,042	391,308	23,841	154,720	12,736	62,163	7.11	6.49	4.88	529.5	152.9	148.9	9.5	9.4	14.2
Middle Atlantic	124,416	1,213,681	34,108	544,020	29,938	149,083	9.76	15.95	4.98	714.1	123.1	264.9	29.4	33.0	34.0
East North Central	114,404	799,421	49,345	307,558	23,257	80,304	6.99	6.23	3.45	895.5	159.9	283.0	19.4	18.6	18.3
West North Central	47,540	316,113	19,027	138,027	9,767	33,331	6.65	7.25	3.41	848.4	129.0	314.4	7.7	8.4	7.6
South Atlantic	26,163	361,011	8,948	95,373	2,516	16,541	13.80	10.66	6.57	2,082.5	278.5	476.6	8.7	5.8	3.8
East South Central	7,592	62,081	3,039	21,656	3,935	7,510	8.18	7.13	1.91	726.6	186.7	188.4	1.5	1.3	1.7
West South Central	15,337	103,765	7,220	42,507	10,633	11,024	6.77	5.89	1.04	841.3	144.1	285.6	2.5	2.6	2.5
Mountain	12,114	235,506	6,091	94,960	2,394	20,953	19.44	15.59	8.75	1,024.0	148.0	353.2	5.7	5.8	4.8
Pacific	32,865	647,733	15,565	250,205	5,888	57,096	19.71	16.07	9.70	1,034.5	158.9	338.2	15.7	15.2	13.0

[1] See page 25 for states composing the several geographic divisions.

In 1902 the so-called flat rate was the principal form of contract between the producer and consumer of electric current. Each year since then has seen a large decrease in the number of stations operating under this form of agreement and a proportionate increase in the metered service, so that at the present time practically all consumers are on a measured current basis. The number of meters reported is not, however, identical with the number of customers, because of the conflicting methods of accounting in use by the different companies; with some each meter is a customer, while with others the customers are counted regardless of the number of meters in service.

The electric railways did not report stationary motors in 1912, but in 1907 they reported 20,468 stationary motors with a capacity of 158,923 horsepower, and in 1902, 10,049 motors with a capacity of 35,688 horsepower.

The largest amount of power capacity of stationary motors at each census was reported by the states of the Middle Atlantic division. In 1912 this division reported 1,213,681 horsepower, or 29.4 per cent of the total for the United States; in 1907, 544,020 horsepower, or 33 per cent of the total; and in 1902, 149,083 horsepower, or 34 per cent of all of this kind of power shown. Although the amount of power reported by this group of states formed a decreasing proportion of the United States total for each succeeding census, still it increased 264.9 per cent from 1902 to 1907, 123.1 per cent from 1907 to 1912, and 714.1 per cent for the decade 1902 to 1912. In 1912 the East North Central group, with 19.4 per cent of the total, and the Pacific states, with 15.7 per cent, were the next largest users of this kind of power. These three groups of states reported nearly two-thirds (64.4 per cent) of the total horsepower for stationary motor service in the United States.

The South Atlantic division, which in 1902 showed but 16,541 horsepower in stationary motors, reported 361,011 horsepower in 1912, an increase of over 2,000 per cent, the largest percentage of gain for any of the geographic divisions. The Pacific and Mountain divisions, in the order named, show the next largest percentages of increase for the 10-year period 1902 to 1912. In 1902 the Middle Atlantic division reported more than one-third (34 per cent) of the total of this kind of power, and the East North Central, the New England, and the Pacific divisions followed, in the order named, with 18.3 per cent, 14.2 per cent, and 13 per cent, respectively. Combined, these four groups of states reported for that year 79.6 per cent of the total for the United States. In 1907 these same groups again led all other divisions in the proportion of the total power reported, but the Pacific division had passed the New England group. In 1912 their relative positions were the same as in 1907. In 1907 the proportion of the total shown by these four divisions combined was 76.2 per cent, and in 1912 a slightly smaller percentage, 73.9, was reported.

Considering the horsepower of stationary motors in the individual states, as shown by Table 55 (p. 82), New York reported 795,256 horsepower in 1912, and led all the others for the three censuses. This horsepower was more than double the amount reported by any other state, with the exception of California, which state was second with 603,742 horsepower. California made the greatest absolute gain from 1907 to 1912, but New York takes precedence in this respect for the decade 1902 to 1912. In addition to the two states named, each of the following states reported more than 100,000 horsepower for stationary motors in 1912: Illinois, Massachusetts, Michigan, Missouri, Ohio, Pennsylvania, and South Carolina.

The largest average horsepower capacity of the motors in 1912 was 38.3, reported for Montana. The states of Utah, South Carolina, Georgia, Nevada, and California followed, in the order named, with average motor horsepowers of 35.9, 28.5, 25.8, 22.4, and 20.8, respectively.

The extensive use of stationary motors of varying capacity in connection with manufactures no doubt accounts for the smaller average capacity per motor in the more eastern states, where the manufacturing industries are largely centralized.

Subsidiary equipment.—At the censuses of 1907 and 1902 data relative to the subsidiary equipment located in the power houses and that in the substations of central electric stations were reported separately. These data have been combined in Table 38 in order to render the totals for 1902 and 1907 comparable with the information as reported at the census of 1912. The table also gives the subsidiary equipment of the electric railways.

Table 38 COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS, AND ELECTRIC RAILWAYS—SUBSIDIARY EQUIPMENT: 1912, 1907, AND 1902.

	Census.	Rotary converters and motor generator sets.[1]		Boosters.		Transformers.	
		Number.	Kilowatt capacity.	Number.	Kilowatt capacity.	Number.	Kilowatt capacity.
Total	1912	4,667	2,646,396	511	47,628	22,304	6,461,336
	1907	2,532	1,305,651	261	21,856	11,062	2,826,693
	1902	742	333,426	297	31,577	3,457	631,936
Central stations	1912	1,827	1,009,136	328	22,821	13,868	4,103,939
	1907	670	363,419	127	4,810	5,788	1,693,532
	1902	301	173,373	193	17,911	1,800	419,367
Commercial	1912	1,781	996,531	295	20,151	12,972	4,039,236
	1907	665	362,706	106	4,474	5,479	1,677,682
	1902	299	173,229	184	17,735	1,765	418,068
Municipal	1912	46	12,605	33	2,670	896	64,703
	1907	5	713	21	336	309	15,850
	1902	2	144	9	176	35	1,299
Electric railways	1912	2,840	1,637,260	183	24,807	8,436	2,357,397
	1907	1,862	942,232	134	17,046	5,274	1,133,161
	1902	441	160,053	104	13,666	1,657	212,569

[1] Prior to 1912 motor generator sets were not included.

Electric railways reported 61.9 per cent of the total kilowatt capacity of rotary converters and motor generator sets in 1912, compared with 72. 2 per cent in 1907 and 48 per cent in 1902. Of the total kilowatt capacity of these machines located in central electric stations, the commercial stations reported 98.8 per cent in 1912, 99.8 per cent in 1907, and 99.9 per cent in 1902.

The capacity of the transformers increased 5,829,400 kilowatts, or 922.5 per cent, from 1902 to 1912. The electric railways reported 36.5 per cent of the total kilowatt capacity of transformers in 1912, 40.1 per cent in 1907, and 33.6 per cent in 1902. For the central stations, the commercial stations reported 98.4 per cent of the kilowatt capacity in 1912, 99.1 in 1907, and 99.7 in 1902. The average capacity of the transformers for all stations increased from 183 kilowatts in 1902 to 290 kilowatts in 1912. As in the case of most machines used in central station work, the average capacity of the transformers increased considerably during the decade 1902–1912. During this period the average capacity of these machines in central stations increased from 233 kilowatts to 296 kilowatts; of those in the commercial stations, from 237 to 311 kilowatts; and of those in municipal stations, from 37 to 72 kilowatts. The average capacity of transformers reported by the electric railways shows a very large increase—from 128 kilowatts in 1902 to 279 in 1912.

The total kilowatt capacity of the boosters shows an increase for the decade 1902–1912 and for the five-year period 1907–1912, but from 1902 to 1907 the figures indicate a decrease. The statistics for boosters for central stations in 1902 and 1907, however, are no doubt incomplete because, unlike the schedule used in 1912, the schedules used in 1902 and 1907 did not specifically call for boosters under the substation equipment, and when these machines were reported they were placed under the general heading of "Miscellaneous." The extent to which boosters were reported in 1902 and 1907, therefore, is uncertain. For the electric railway industry there has been a steady increase in the capacity of these machines.

CHAPTER VI.

FINANCIAL STATISTICS.

Capitalization.—The statistics of capitalization of central electric light and power stations for prior censuses were confined to the par value of authorized and outstanding preferred and common stock and bonds of commercial corporations; the par value of the bonds issued by municipalities to secure funds for the construction, purchase, or operation of the municipal stations; and the returns made on such capitalization in the form of dividends and interest. For the year 1912, however, a more extended report was requested, and a balance sheet as of December 31, 1912, was secured from all central stations, commercial and municipal. The capitalization for 1912, therefore, includes for commercial companies, in addition to capital stock and funded debt, the cash investments, value of real estate mortgages, and floating debt.

The balance sheet for municipal central stations shows funded debt amounting to $31,189,357 and cash investments amounting to $27,064,963, which together aggregate $58,254,320. It is doubtful, however, that this sum fairly represents the capitalization of this class of stations, since no cognizance is taken of the indebtedness which has been liquidated. In Table 39, therefore, the capitalization of municipal stations for 1912 is given as the amount reported for the cost of construction and equipment.

Table 39	Central electric stations—Capitalization: 1912.
Total	$2,289,622,199
Commercial stations	2,212,557,055
Capital stock	1,154,587,016
Common	977,639,057
Preferred	176,947,959
Funded debt	897,907,681
Cash investments	12,165,075
Real estate mortgages	10,170,898
Floating debt	137,726,385
Municipal stations:	
Cost of construction and equipment	77,065,144

Of the total capitalization in 1912, as shown in Table 39, the commercial stations reported 96.6 per cent and the municipal stations 3.4 per cent. The capital stock, of which 84.7 per cent was common stock and 15.3 per cent preferred, represented 50.4 per cent of the total capitalization. The funded debt was equal to 39.2 per cent of the total capitalization, the floating debt to 6 per cent, the cash investments to five-tenths of 1 per cent, and real estate mortgages to four-tenths of 1 per cent.

Gross and net capital, commercial stations.—In the preceding table the total capitalization of the industry as a whole is shown. The table which follows gives for commercial companies the gross and net capital and the net capital pertaining strictly to the electric light and power industry.

Table 40	Commercial central electric stations—Gross and net capital: 1912.
Common stock	$977,639,057
Preferred stock	176,947,959
Funded debt	897,907,681
Cash investments	12,165,075
Real estate mortgages	10,170,898
Floating debt	137,726,385
Total	2,212,557,055
Deduct intercompany holdings and treasury securities	126,305,618
Net capital	2,086,251,437
Deduct investments outside of electric light and power industry	76,721,716
Net capital based on electric light and power industry	2,009,529,721

To arrive at the net capital it is necessary to deduct intercompany holdings, $77,787,160, and treasury securities, $48,518,458, leaving $2,086,251,437 as the net capital. The intercompany holdings or the stocks and bonds of certain electric companies held by other electric companies are deducted, since they have been reported as capitalization by the companies which originally issued them, and their inclusion by a purchasing company is a duplication. In like manner, treasury securities constitute a duplication, since they represent stock or bonds legally ready for disposal, which have already been reported as outstanding capitalization but held in the treasury subject to issue.

To arrive at the net capital pertaining strictly to the electric light and power industry it is necessary to deduct outside investments. These include investments in the stock and bonds of companies other than electric, $65,895,784, and other permanent investments, $10,825,932, a total amounting to $76,721,716, leaving $2,009,529,721 as the net capital based on the electric light and power industry. It will be seen from these figures that after the elimination of the duplications referred to the net capital shows a shrinkage of 5.7 per cent, as compared with the gross capital, while the net capital based on the electric light and power industry shows a falling off of 9.2 per cent, as compared with the gross capital.

Capital stock and funded debt of commercial stations.—In order to present comparative statistics of capitalization it is necessary to use the totals as secured at the censuses of 1907 and 1902. The data are confined, therefore, to those for the commercial stations, since the statistics of capitalization for municipal stations are unsatisfactory.

COMMERCIAL COMPANIES—CAPITAL STOCK, FUNDED DEBT, AND DIVIDENDS: 1912, 1907, AND 1902.

Table 41	1912	1907	1902	PER CENT OF INCREASE.		
				1902-1912	1907-1912	1902-1907
Number of commercial companies having outstanding capitalization	[1] 2,663	[2] 2,516	2,049	30.0	5.8	22.8
Total capitalization outstanding	$2,052,494,697	$1,341,995,182	$627,515,875	227.1	52.9	113.9
Capital stock	1,154,587,016	741,317,497	372,951,952	209.6	55.7	98.8
Common	977,639,057	666,003,772	349,080,281	180.1	46.8	90.8
Preferred	176,947,959	75,313,725	23,871,671	641.2	134.9	215.5
Dividends, amount	34,580,872	19,300,572	6,189,837	458.7	79.2	211.8
On common stock	28,602,399	16,883,812	5,560,341	414.4	69.4	203.6
On preferred stock	5,978,473	2,416,760	629,496	849.7	147.4	283.9
Funded debt	897,907,681	600,677,685	254,563,923	252.7	49.5	136.0

[1] Exclusive of the capitalization of 169 electric railways which operated electric light and power departments, and 116 central electric stations not reporting stock and bonds for sundry reasons, but including 18 stations whose capitalization was reported by other stations, and 23 stations reporting bonds only.

[2] Exclusive of 37 companies (21 operating electric railways with capitalization included in report for street and electric railways; 9 corporations reporting capitalization in one state and owning establishments in another state, which are reported separately in certain of the tables; and 7 not reporting capitalization for sundry reasons), but including 2 companies reporting bonds only, their capital stock not being separable from that representing other interests.

The capitalization of commercial companies increased $714,479,307, or 113.9 per cent, from 1902 to 1907, and $710,499,515, or 52.9 per cent, from 1907 to 1912. The kilowatt-hour output shown in Table 29 increased 141.1 per cent and 97.3 per cent, respectively, for the same periods. It will be seen, therefore, that there was a harmonious relation between the percentages of increase in capitalization and in output.

The number of stations reporting capitalization increased 147, or 5.8 per cent, from 1907 to 1912, as compared with an increase of 467, or 22.8 per cent, from 1902 to 1907. Of the entire capitalization, the total capital stock formed 56.3 per cent in 1912, 55.2 per cent in 1907, and 59.4 per cent in 1902, while bonds (funded debt) represented 43.7 per cent, 44.8 per cent, and 40.6 per cent, respectively. The relative importance of stocks and bonds, therefore, showed considerable variation between 1902 and 1907, but changed only slightly between 1907 and 1912.

The funded debt increased $346,113,762, or 136 per cent, from 1902 to 1907, and $297,229,996, or 49.5 per cent, from 1907 to 1912. There has been a gradual lessening in the proportion of common stock, from 93.6 per cent of the total capital stock in 1902 to 89.8 per cent in 1907 and 84.7 per cent in 1912, and necessarily a corresponding increase in the percentage for preferred stock.

The statistics of capitalization collected by the Census Bureau should not be used as a basis for computing the return on investments in central electric stations. Many companies operate other industries in connection with central stations, and their systems of accounting are such that it is impossible to obtain data pertaining to the investment, income, and expenses for each branch, although the information for the entire enterprise may be very complete.

However, in 1912 the 2,663 commercial companies reported dividends on common stock to the amount of $28,602,399, being equivalent to 2.9 per cent on $977,639,057 of common stock, as compared with 2.5 per cent in 1907 and 1.6 per cent in 1902. The amount of dividends on the preferred stock in 1912 was $5,978,473, equal to 3.4 per cent; in 1907 the rate was 3.2 per cent, and in 1902, 2.6 per cent. Some of the 2,663 companies reported for 1912 did not pay dividends for the census year, while others declared them upon one class of stock only.

Cost of construction and equipment.—The schedule used at the census of 1902 called for a separate statement as to the cost, during the year and to date, of land; buildings; machinery, tools, and implements within stations; overhead electric service construction; underground electric service construction; lamps, motors, meters, and transformers, wired for use; supplies of every description on hand; and miscellaneous equipment. The object of these inquiries was to ascertain the total cost of the plant and equipment, and the expenditures during the year for extensions, additions, and repairs. It was presumed that the electric companies kept an account of this kind, but a majority contended that it was impossible to report the cost in such detail, and many asserted that they had no data from which even the total cost of the plant and equipment to date could be estimated with a fair degree of accuracy. Moreover, a considerable number of the electric stations have changed ownership during recent years, and the purchase price often has little relation to the actual cost of the plant, and in fact seldom, if ever, represents this cost. The transfer is frequently made through the exchange of stock or by some other arrangement whereby it is impossible to ascertain the money equivalent. In view of these conditions the attempt to ascertain the cost of construction in such detail was abandoned in 1907, but in an effort to preserve the comparative value of the statistics the total cost of the plant and equipment to date and the cost of construction during the census year were requested. Even this modification of the inquiry was unsatisfactory, and in 1912 it was still further simplified, and only the total cost of construction, equipment, and real estate was called for.

Many and varying factors enter into the cost of plants and equipment. Sites and rights, which in one instance may cost but little, in another may be very expensive. The equipment of a station designed and prepared to supply current to a large city or thickly settled community is quite unlike that of a station transmitting electricity considerable distances and selling in bulk to but few customers.

Notwithstanding these limitations the data presented in the following table may be accepted as presenting a fair approximation of the growth of the industry in respect to cost of construction and equipment for the United States, for the several geographic divisions, and for the individual states.

CENTRAL ELECTRIC STATIONS—COST OF CONSTRUCTION AND EQUIPMENT: 1912, 1907, AND 1902.

Table 42

DIVISION AND STATE.	TOTAL COST OF CONSTRUCTION AND EQUIPMENT.			Actual increase: 1902–1912	Per cent of increase: 1902–1912
	1912	1907	1902		
UNITED STATES	$2,175,678,266	$1,096,913,622	$504,740,352	$1,670,937,914	331.0
GEOGRAPHIC DIVISIONS:					
New England	153,468,258	92,582,350	55,538,120	97,930,138	176.3
Middle Atlantic	584,107,361	391,858,983	211,010,618	373,096,743	176.8
East North Central	388,575,873	203,859,358	87,654,667	300,921,206	343.3
West North Central	170,306,935	86,378,753	39,840,684	130,466,251	327.5
South Atlantic	134,310,186	58,513,594	19,462,480	114,847,706	590.1
East South Central	74,964,574	27,384,959	9,081,612	65,882,962	725.5
West South Central	76,052,774	31,981,172	13,247,115	62,805,659	474.1
Mountain	203,195,798	57,380,775	23,662,909	179,532,889	758.7
Pacific	390,696,507	146,973,678	45,242,147	345,454,360	763.6
NEW ENGLAND:					
Maine	19,926,292	12,629,101	4,824,850	15,101,442	313.0
New Hampshire	18,061,576	8,695,652	6,447,560	11,614,016	180.1
Vermont	10,027,600	7,234,498	2,691,170	7,336,430	272.6
Massachusetts	71,707,238	43,279,226	29,562,267	42,144,971	142.6
Rhode Island	11,339,294	7,327,862	5,428,796	5,910,498	108.9
Connecticut	22,406,258	13,416,011	6,583,477	15,822,781	240.3
MIDDLE ATLANTIC:					
New York	350,526,904	252,731,789	112,998,778	237,528,126	210.2
New Jersey	69,058,381	65,219,445	56,432,502	12,625,879	22.4
Pennsylvania	164,522,076	73,907,749	41,579,338	122,942,738	295.7
EAST NORTH CENTRAL:					
Ohio	69,243,894	42,557,000	26,381,397	42,862,497	162.5
Indiana	47,930,252	25,680,710	6,706,510	41,223,742	614.7
Illinois	162,104,226	88,142,233	38,329,275	123,774,951	322.9
Michigan	72,764,830	37,001,060	11,559,169	61,205,661	529.5
Wisconsin	36,532,671	10,478,355	4,678,316	31,854,355	680.9
WEST NORTH CENTRAL:					
Minnesota	44,360,910	24,138,081	9,236,505	35,124,405	380.3
Iowa	22,126,518	9,986,666	8,554,234	13,572,284	158.7
Missouri	48,624,710	33,865,760	15,679,872	32,944,838	210.1
North Dakota	4,881,632	1,619,997	416,843	4,464,789	1,071.1
South Dakota	11,318,041	2,806,363	623,504	10,694,537	1,715.2
Nebraska	12,971,316	7,372,081	3,305,840	9,665,476	292.4
Kansas	26,023,808	6,589,805	2,023,886	23,999,922	1,185.8
SOUTH ATLANTIC:					
Delaware, Maryland, and District of Columbia	39,970,422	34,010,868	11,825,756	28,144,666	238.0
Virginia	10,927,379	1,790,271	1,039,347	9,888,032	951.4
West Virginia	13,390,173	2,682,935	1,123,449	12,266,724	1,091.9
North Carolina	12,090,231	2,241,791	803,936	11,286,295	1,403.9
South Carolina	34,012,368	8,803,382	2,442,989	31,569,379	1,292.2
Georgia	19,890,925	7,354,286	1,252,578	18,638,347	1,488.0
Florida	4,028,688	1,630,061	974,425	3,054,263	313.4
EAST SOUTH CENTRAL:					
Kentucky	19,709,023	10,356,088	3,670,152	16,038,871	437.0
Tennessee	41,517,416	7,514,333	3,603,088	37,914,328	1,052.3
Alabama	8,726,776	7,293,876	908,895	7,817,881	860.2
Mississippi	5,011,359	2,220,662	899,477	4,111,882	457.1
WEST SOUTH CENTRAL:					
Arkansas	4,811,879	1,922,658	1,082,505	3,729,374	344.5
Louisiana	14,275,269	11,614,121	6,056,603	8,218,666	135.7
Oklahoma	13,352,640	7,130,864	597,516	12,755,124	2,134.7
Texas	43,612,986	11,313,529	5,510,491	38,102,495	691.5
MOUNTAIN:					
Montana	64,583,391	17,950,677	4,740,807	59,842,584	1,262.3
Idaho	32,482,566	3,251,460	785,030	31,697,536	4,037.7
Wyoming	2,200,032	942,326	467,463	1,732,569	370.6
Colorado	66,989,142	23,126,179	8,665,826	58,323,316	673.0
New Mexico	3,133,760	989,317	369,877	2,763,883	747.2
Arizona	9,258,049	1,672,589	810,341	8,447,708	1,042.5
Utah	11,555,496	5,148,596	7,521,780	4,033,716	53.6
Nevada	12,993,362	4,299,631	301,785	12,691,577	4,205.5
PACIFIC:					
Washington	22,510,528	20,789,849	3,537,022	18,973,506	536.4
Oregon	23,796,747	14,403,278	5,157,651	18,639,096	361.4
California	344,389,232	111,780,551	36,547,474	307,841,758	842.3

The cost of construction of central electric plants, which includes that of the equipment devoted to the generation and distribution of electric current, for the United States as a whole, increased $1,670,937,914, or 331 per cent, from 1902 to 1912. In all of the geographic divisions, with the exception of the New England, the Middle Atlantic, and the West North Central, the per cent of increase was greater than the rate of gain for the United States. The largest percentage of increase, 763.6 per cent, is shown for the Pacific group; the Mountain division is second, with 758.7 per cent; and the East South Central group third, with 725.5 per cent. The largest actual gain, $373,096,743, was in the Middle Atlantic states, and the relative value of the equipment in this group may be better understood when it is considered that the amount representing this *increase* was greater than the total amount of the entire investment reported in 1912 by the central electric stations in any other group except the East North Central and Pacific divisions. This latter division was second in the amount of actual increase, and the East North Central third.

Several of the geographic divisions show considerable change in their respective proportions of the cost of construction and equipment in 1912, as compared with their proportions in 1902. The most noticeable decreases are as follows: The Middle Atlantic division, from 41.8 per cent in 1902 to 26.8 per cent in 1912, and the New England division, from 11 per cent to 7.1 per cent. Of the increases during the 10-year period, those for the Pacific division from 9 per cent in 1902 to 18 per cent in 1912, and for the Mountain division from 4.7 per cent to 9.3 per cent, were the most pronounced.

Considering the states individually, New York had the largest amount invested at all three censuses, although California reported the greatest increase, $307,841,758, during the decade. The greatest percentages of increase are shown for Nevada and Idaho. Oklahoma shows a gain of more than 2,000 per cent, and 10 other states—Arizona, Georgia, Kansas, Montana, North and South Carolina, North and South Dakota, Tennessee, and West Virginia—made increases of over 1,000 per cent from 1902 to 1912. These large percentages of increase, however, represent the states wherein the electrical industries were practically undeveloped 10 years ago. Important water powers are located in many of these states, and by their utilization electricity is generated at a minimum cost. The water powers in the Pacific, Mountain, and East South Central states have been developed very extensively during the past decade, and the states in these divisions show the largest increases in the cost of construction and equipment of central electric systems.

Table 43 gives for commercial and municipal stations the total number of stations, the cost of construction and equipment, the kilowatt capacity of dynamos, the horsepower of primary machines, and the average cost of construction per kilowatt capacity of dynamos and per horsepower of prime movers, for 1912, 1907, and 1902.

COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—COST OF CONSTRUCTION AND EQUIPMENT; AVERAGE COST OF CONSTRUCTION PER KILOWATT CAPACITY OF DYNAMOS AND PER HORSEPOWER OF PRIMARY POWER MACHINES: 1912, 1907, AND 1902.

Table 43	TOTAL.			COMMERCIAL.			MUNICIPAL.		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of stations	5,221	4,714	3,620	3,659	3,462	2,805	1,562	1,252	815
Cost of construction and equipment	$2,175,678,266	$1,096,913,622	$504,740,352	$2,098,613,122	$1,054,034,175	$482,719,879	$77,065,144	$42,879,447	$22,020,473
Kilowatt capacity of dynamos	5,134,689	2,709,225	1,212,235	4,766,012	2,500,209	1,098,855	368,677	209,016	113,380
Average cost of construction per kilowatt capacity of dynamos	$424	$405	$416	$440	$422	$439	$209	$205	$194
Horsepower of primary power machines	7,528,648	4,098,188	1,845,048	6,969,320	3,776,837	1,685,020	559,328	321,351	160,028
Average cost of construction per horsepower of primary power machines	$289	$268	$274	$301	$279	$286	$138	$133	$138

The total cost of construction and equipment for all stations reported for 1912 was an increase of $1,078,764,644 over the cost reported in 1907, or 98.3 per cent. For the same period the commercial stations increased $1,044,578,947, or 99.1 per cent, and the municipal stations $34,185,697, or 79.7 per cent. The commercial stations reported 96.5 per cent of the total cost of construction for the 5,221 central electric stations in 1912 and 95.6 per cent of the total for the 3,620 stations in 1902. The average cost per station in 1912 was $416,717, as compared with $232,693 in 1907 and $139,431 in 1902. The averages per station for the commercial stations for the same years were $573,548, $304,458, and $172,093, and for municipal stations $49,337, $34,249, and $27,019, respectively. The average cost of construction per kilowatt capacity of dynamos for all stations decreased from $416 in 1902 to $405 in 1907, but increased to $424 for 1912. Similar changes took place in the average cost per horsepower of prime movers, which decreased from $274 in 1902 to $268 in 1907, but increased to $289 in 1912. The averages for commercial stations are in harmony with those for all stations, but for municipal stations the average cost of construction per kilowatt capacity has increased during each five-year period, while the average for the primary power units was the same in 1912 as in 1902, although showing a decrease from 1902 to 1907.

Income.—The schedule used at the census of 1912 called for returns of income in less detail than in 1907 and 1902, because the detailed information secured in the earlier years was unsatisfactory. In the census of 1907, for instance, the attempt was made to secure separate income data for arc and for incandescent lighting, for stationary motor service, for charging automobiles, and for electric heating, cooking, welding, etc., but these were all abandoned as separate inquiries in 1912.

The inquiries as to income, and also as to operating expenses, used in the schedule for 1912, with slight modifications, conform to the system of accounting adopted by the United States Interstate Commerce Commission. The different items of income for which separate totals were reported are shown in Table 44. This table also shows the per cent each item forms of the total income.

Table 44 CENTRAL ELECTRIC STATIONS—INCOME: 1912.

ACCOUNT.	Amount.	Per cent of total.
Total income	$302,115,599	100.0
Electric service	286,980,858	95.0
Commercial light, power. and heat	221,200,466	73.2
Municipal street lighting	27,273,226	9.0
Municipal building lighting	2,504,511	0.8
Current sold to other public service corporations	31,019,660	10.3
Estimated value of free service:		
Commercial stations	513,644	0.2
Municipal stations	4,469,351	1.5
Interest and dividends from investments	4,891,449	1.6
All other sources	10,243,292	3.4

The great bulk of the income was for electric service, but 5 per cent of the total income being derived from other sources. As might be expected, most of the income (nearly three-fourths) was reported for commercial light, power, and heat. Current sold to other public service corporations was second in importance, and municipal street lighting, shown separately for the first time at the census of 1912, was third. The income from interest and dividends from investments and all other income were comparatively unimportant. The estimated value of free service formed but 1.7 per cent of the total income. In 1912 the estimated amount reported for free service was $4,982,995, while in 1907 this item was reported as $6,010,595, indicating a decrease during the five-year period of $1,027,600, or 17.1 per cent. Although in 1912 a small amount ($513,644) was shown for such service for commercial stations, for franchise privileges, etc., free service was chiefly reported by the municipal stations, such stations reporting 89.7 per cent of the total in 1912 and 94.4 per cent in 1907.

The differences in reporting the items of income at the several censuses render it impracticable to give comparative figures, except for gross income, for electric service, and for receipts from all other sources. Data relating to these three items of income and to the number of stations are shown for commercial and municipal stations for 1912, 1907, and 1902.

The municipal stations formed 22.5 per cent of the total number reported at the census of 1902. This proportion increased to 26.6 per cent in 1907 and 29.9 per cent in 1912. This increase in number, however, loses much of its significance when it is considered that the gross income of the municipal stations formed only 8.1 per cent of the total income of both classes of stations in 1902, 8 per cent in 1907, and 7.7 per cent in 1912.

Table 45 COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—GROSS INCOME: 1912, 1907, AND 1902.

CLASSIFICATION OF INCOME.	Census.	Total.	Commercial.	Municipal.
Number of stations	1912	5,221	3,659	1,562
	1907	4,714	3,462	1,252
	1902	3,620	2,805	815
Gross income	1912	$302,115,599	$278,896,610	$23,218,989
	1907	175,642,338	161,630,339	14,011,999
	1902	85,700,605	78,735,500	6,965,105
Electric service	1912	286,980,858	264,317,150	22,663,708
	1907	169,614,691	156,000,257	13,614,434
	1902	84,186,605	77,349,749	6,836,856
All other sources	1912	15,134,741	14,579,460	555,281
	1907	6,027,647	5,630,082	397,565
	1902	1,514,000	1,385,751	128,249
Per cent of increase:				
Number of stations—				
1902–1912		44.2	30.4	91.7
1907–1912		10.8	5.7	24.8
1902–1907		30.2	23.4	53.6
Gross income—				
1902–1912		252.5	254.2	233.4
1907–1912		72.0	72.6	65.7
1902–1907		104.9	105.3	101.2
Electric service—				
1902–1912		240.9	241.7	231.5
1907–1912		69.2	69.4	66.5
1902–1907		101.5	101.7	99.1
All other sources—				
1902–1912		899.7	952.1	333.0
1907–1912		151.1	159.0	39.7
1902–1907		298.1	306.3	210.0

Table 56 (p. 88) shows that in income, as in most other features of the industry, the Middle Atlantic and East North Central divisions lead all others, these two divisions combined reporting in 1912 $160,005,679, or 53 per cent of the total income. The Pacific division was third in gross income, with $32,195,997, or 10.7 per cent of the total. With few exceptions these three divisions lead in the several items of income shown in Table 56. For municipal building lighting the Middle Atlantic division reported $1,287,893, or 51.4 per cent of the total for such service; and for interest and dividends from investments, $2,529,416, or 51.7 per cent of the total. In estimated value of free service for municipal stations, the East North Central division led, with $1,846,837, or 41.3 per cent, while of the total shown for "all other income" this division reported $3,484,991, or 34 per cent. Four of the states showed a gross income in 1912 of upward of $20,000,000, as follows: New York, $57,218,973; Illinois, $30,045,297; California, $27,685,573; and Pennsylvania, $24,387,863; their proportions of the total income being 18.9 per cent, 9.9 per cent, 9.2 per cent, and 8.1 per cent, respectively. In the amounts reported for commercial light, power, and heat these four states also led, but with California instead of Illinois in second position. The amounts reported for this service were: New York, $42,388,607, or 19.2 per cent; California, $19,941,719, or 9 per cent; Illinois, $19,693,842, or 8.9 per cent; and Pennsylvania, $16,811,493, or 7.6 per cent. In income for municipal street lighting, New York reported $4,556,339, or 16.7 per cent of the total for such service; Pennsylvania, $3,363,079, or 12.3 per cent; and Massachusetts,

$2,322,146, or 8.5 per cent. In income for current sold to other public-service corporations, Illinois led, with $5,231,534, or 16.9 per cent, followed by New York, with $5,090,032, or 16.4 per cent; California, with $4,763,032, or 15.4 per cent; and Pennsylvania, with $2,801,257, or 9 per cent. No other state reported as much as $2,000,000 for such service.

Diagram 15.—Central Electric Stations—Gross Income, by States: 1912, 1907, and 1902.

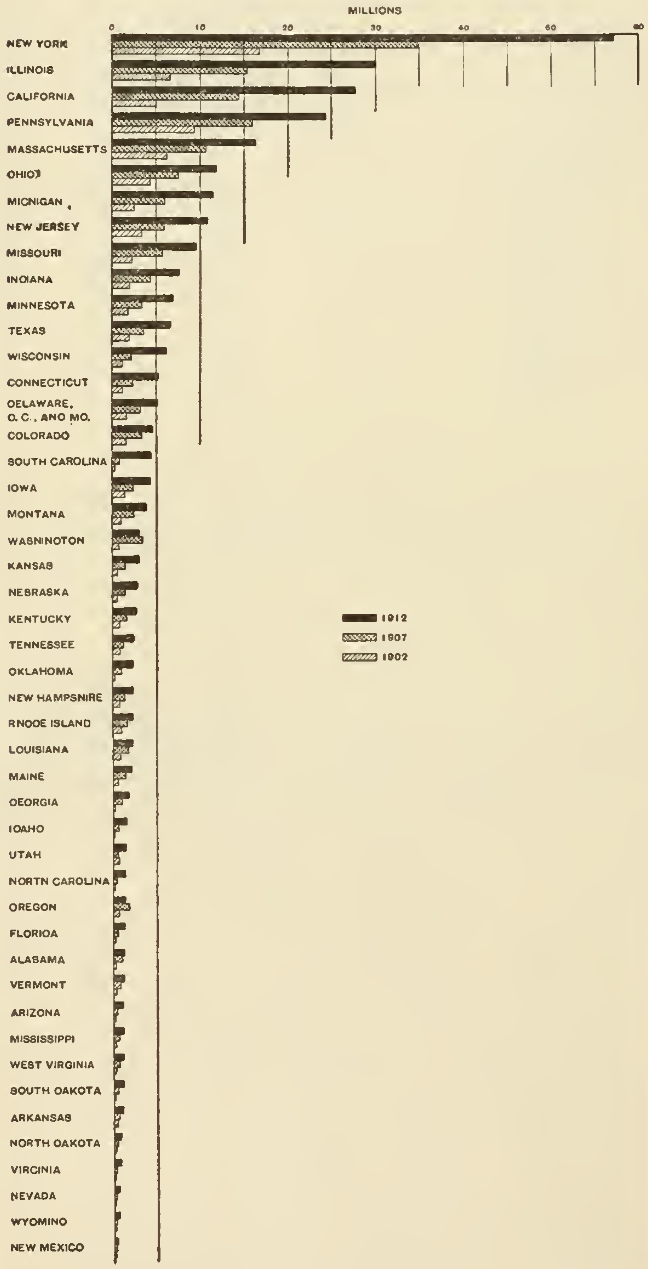
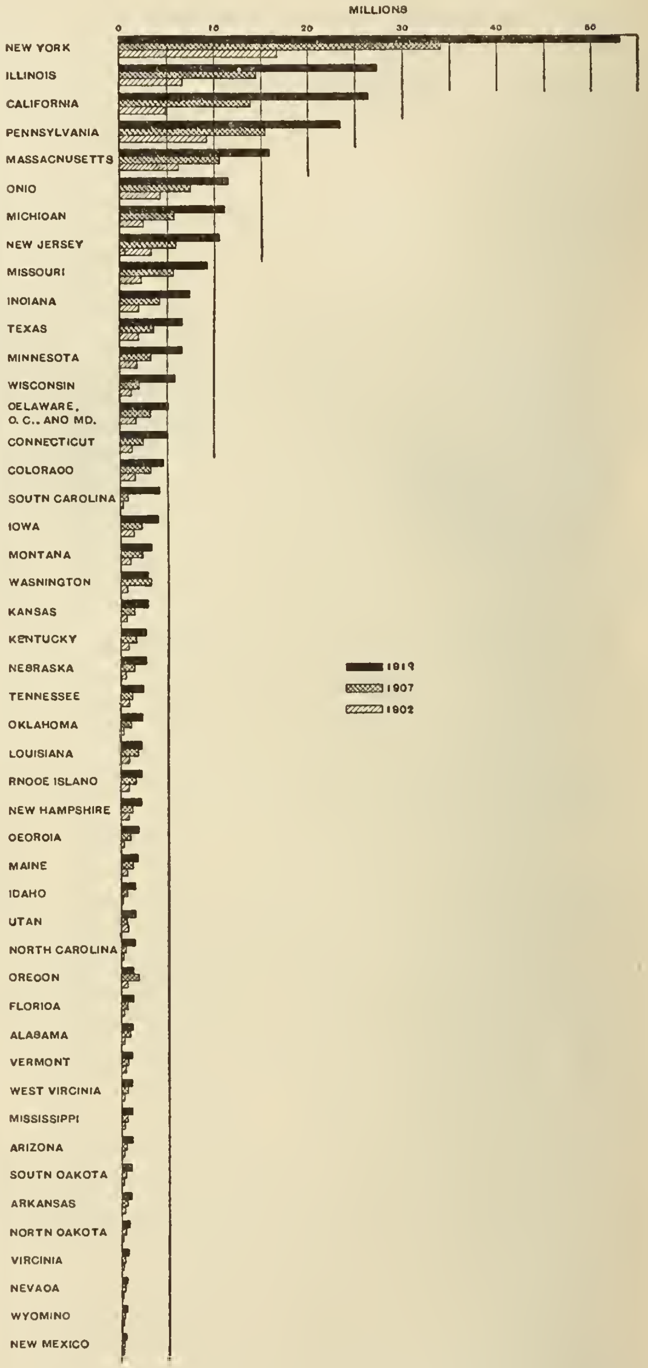


Diagram 16.—Central Electric Stations—Income from Electric Service, by States: 1912, 1907, and 1902.



Changes in the size of the dynamos used in central stations and data as to earning capacity in respect to size are presented in the following comparative table, which gives for 1912, 1907, and 1902 the gross income for stations grouped according to dynamo capacity.

CENTRAL ELECTRIC STATIONS—GROSS INCOME FOR STATIONS GROUPED ACCORDING TO DYNAMO CAPACITY: 1912, 1907, AND 1902.

Table 46

CLASS OF INCOME.	Census.	Total.	STATIONS GROUPED ACCORDING TO DYNAMO CAPACITY. Under 200 kilowatts.	200 and under 500 kilowatts.	500 and under 1,000 kilowatts.	1,000 and under 2,000 kilowatts.	2,000 and under 5,000 kilowatts.	5,000 kilowatts and over.	Stations having no generating equipment.
Number of stations	1912	5,221	2,902	948	337	214	152	161	507
	1907	4,714	3,038	821	269	169	115	75	227
	1902	3,620	2,587	586	172	98	67	32	78
Per cent of increase: 1902–1912		44.2	12.2	61.8	95.9	118.4	126.9	403.1	550.0
Gross income	1912	$302,115,599	$16,625,878	$18,111,238	$14,079,923	$16,518,054	$25,448,529	$188,434,343	$22,897,634
	1907	175,642,338	17,140,070	14,786,719	10,465,110	13,149,808	21,915,199	89,930,073	8,255,359
	1902	85,700,605	14,440,351	10,409,319	7,001,486	8,414,307	13,839,846	30,027,061	1,568,235
Per cent of increase: 1902–1912		252.5	15.1	74.0	101.1	96.3	83.9	527.5	1,360.1
Electric service	1912	286,980,858	15,934,092	17,166,227	13,322,200	15,832,795	24,398,710	179,107,243	21,219,591
	1907	169,614,691	16,344,745	13,954,088	10,075,476	12,617,855	21,277,402	87,277,832	8,067,293
	1902	84,186,605	14,090,189	10,122,092	6,896,143	8,175,941	13,635,206	29,756,206	1,510,828
Per cent of increase: 1902–1912		240.9	13.1	69.6	93.2	93.7	78.9	501.9	1,304.5
All other sources	1912	15,134,741	691,786	945,011	757,723	685,259	1,049,819	9,327,100	1,678,043
	1907	6,027,647	795,325	832,631	389,634	531,953	637,797	2,652,241	188,066
	1902	1,514,000	350,162	287,227	105,343	238,366	204,640	270,855	57,407
Per cent of increase: 1902–1912		899.7	97.6	229.0	619.3	187.5	413.0	3,343.6	2,823.1

The distinctive changes brought out by this table are the exceptionally large growth of income for stations with dynamos of the largest capacity and the remarkable increase in that for stations without generating equipment.

Between 1902 and 1912 the total income increased by $216,414,994, of which amount the increase for the stations reporting a dynamo capacity of 5,000 kilowatts and over was $158,407,282, or 73.2 per cent, and for the stations without generating equipment, $21,329,399, or 13.5 per cent; the increases for these two classes alone thus representing 86.7 per cent of the total growth. In 1902, of the total income for electric service that for stations reporting dynamos of 5,000 kilowatts and over represented 35.3 per cent and that for stations without generating equipment 1.8 per cent. In 1912 the proportions for these classes of stations had increased to 62.4 per cent and 7.4 per cent, respectively.

The smallest increase in gross income during the decade is shown for the stations having less than 200-kilowatt capacity, while, on the other hand, the largest increase for stations reporting dynamos is shown for those of 5,000 kilowatts and over.

The largest percentage of increase in gross income for any class of stations in the table is reported for the stations having no generating equipment, which emphasizes the growth in the operations of stations using purchased current. This condition has largely been brought about by the economy connected with the generation of electricity in stations of large dynamo capacity, which is made available over large areas by means of long-distance transmission lines.

Expenses.—Details for expenses, like details for income, were reported differently at the several censuses. In the following table the expenses are shown in detail as reported in 1912, with the percentage which each item of expense forms of the total.

Table 47

ACCOUNT.	CENTRAL ELECTRIC STATIONS—EXPENSES: 1912. Amount.	Per cent of total.
Total expenses	$234,419,478	100.0
Fuel	34,748,754	14.8
Electric current and electric power purchased	18,074,344	7.7
Rent of offices, conduits, underground and water privileges	4,279,596	1.8
Supplies, materials, salaries and wages, and other miscellaneous expenses, not elsewhere specified	91,847,508	39.2
Taxes:		
Real and personal property	8,048,291	3.5
Capital stock	997,012	0.4
Federal corporation	558,706	0.2
Earnings	2,598,338	1.1
Miscellaneous	944,991	0.4
Interest on funded and floating debt	48,302,900	20.6
Injuries and damages	1,200,989	0.5
Insurance	2,320,151	1.0
Charges for depreciation	18,843,863	8.0
Charges for sinking fund	1,654,035	0.7

Of the expenses reported in 1912, supplies, etc., constituted the chief item, and formed 39.2 per cent of the total; interest on funded and floating debt, 20.6 per cent, was second; and cost of fuel, 14.8 per cent, was third. Charges for depreciation and charges for sinking fund, not reported at prior censuses, combined formed 8.7 per cent of the expenses; and taxes, which are reported in considerable detail, formed 5.6 per cent.

For comparison with prior censuses it is necessary to arrange the expenses into the four groups for which separate figures are given in the following table. The total for supplies, materials, and salaries and wages includes sundry expenses incident to operation and maintenance, such as advertising, law expenses, telegraph and telephone service, power other than electric, and expenses of a similar character not elsewhere reported. In the reports for 1902 and 1907 interest on funded debt was treated as a fixed charge and not as an item of expense; but to make the data for these two years comparable with the figures for 1912, interest amounting to $27,991,762 in 1907 and $12,623,545 in 1902 has been included with the expenses for those two years. The total for rent of offices, etc., in 1912 includes charges for depreciation, $18,843,863, and charges for sinking fund, $1,654,035, or $20,497,898 in all for items that were not reported at the censuses of 1907 and 1902.

Table 48 COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—EXPENSES: 1912, 1907, AND 1902.

CLASS.	Total.	Commercial.	Municipal.	Per cent of total.	
				Commercial.	Municipal.
Number of stations:					
1912	5,221	3,659	1,562	70.1	29.9
1907	4,714	3,462	1,252	73.4	26.6
1902	3,620	2,805	815	77.5	22.5
Total expenses:					
1912	$234,419,478	$217,502,313	$16,917,165	92.8	7.2
1907	134,196,911	123,880,291	10,316,620	92.3	7.7
1902	68,081,375	62,835,388	5,245,987	92.3	7.7
Rent of offices, conduits, and water privileges; taxes, interest on funded and floating debt, injuries and damages, insurance, and charges for depreciation and sinking fund—					
1912	89,748,872	87,022,175	2,726,697	97.0	3.0
1907	51,061,122	49,434,241	1,626,881	96.8	3.2
1902	21,817,004	21,094,560	722,444	96.7	3.3
Cost of fuel—					
1912	34,748,754	30,373,445	4,375,309	87.4	12.6
1907	23,057,745	19,824,962	3,232,783	86.0	14.0
1902	11,635,509	10,189,685	1,445,824	87.6	12.4
Electric power purchased—					
1912	18,074,344	16,912,612	1,161,732	93.6	6.4
1907	6,417,237	6,080,905	336,332	94.8	5.2
1902	[1] 2,130,759	[1] 2,007,193	[1] 123,566	94.2	5.8
Supplies and materials, including salaries and wages, and other expenses not elsewhere included—					
1912	91,847,508	83,194,081	8,653,427	90.6	9.4
1907	53,660,807	48,540,183	5,120,624	90.5	9.5
1902	32,498,103	29,543,950	2,954,153	90.9	9.1
Per cent of increase:					
Number of stations—					
1902–1912	44.2	30.4	91.7	......	......
1907–1912	10.8	5.7	24.8	......	......
1902–1907	30.2	23.4	53.6	......	......
Total expenses—					
1902–1912	244.3	246.1	222.5	......	......
1907–1912	74.7	75.6	64.0	......	......
1902–1907	97.1	97.2	96.7	......	......
Rent of offices, conduits, and water privileges; taxes, interest on funded and floating debt, injuries and damages, insurance, and charges for depreciation and sinking fund—					
1902–1912	311.4	312.5	277.4	......	......
1907–1912	75.8	76.0	67.6	......	......
1902–1907	134.0	134.3	125.2	......	......
Cost of fuel—					
1902–1912	198.6	198.1	202.6	......	......
1907–1912	50.7	53.2	35.3	......	......
1902–1907	98.2	94.6	123.6	......	......
Electric power purchased—					
1902–1912	748.3	742.6	840.2	......	......
1907–1912	181.7	178.1	245.4	......	......
1902–1907	201.2	203.0	172.2	......	......
Supplies and materials, including salaries and wages, and other expenses not elsewhere included—					
1902–1912	182.6	181.6	192.9	......	......
1907–1912	71.2	71.4	69.0	......	......
1902–1907	65.1	64.3	73.3	......	......

[1] Includes a small amount paid for power other than electric.

In 1912 the largest single item of expense, $91,847,508, was for supplies and materials, etc., which formed 39.2 per cent of the total expenses for that year, as compared with 47.7 per cent in 1902. The largest percentages of increase are shown for electric power purchased, and although the amount shown for this item forms but a small proportion of the total, the increased percentage in 1912 is in harmony with the general trend toward the concentration of generating stations into larger units of capacity and the purchase of current by the smaller ones wherever practicable. In fact, the economy of large units is generally recognized in the electrical world.

Of the total expenses, the proportions contributed by the two classes of stations, commercial and municipal, vary but little from census to census. For the municipal stations the largest proportion for any one item, 12.6 per cent in 1912 and 12.4 per cent in 1902, is shown for cost of fuel. These stations are generally small and built to meet the demands of the municipalities, and water-power is seldom available. The municipal stations, for instance, in 1912 reported 20.2 per cent of the total horsepower for gas and oil engines, 8.2 per cent of the total for steam power, and for water power but 5.3 per cent.

Balance sheet, commercial companies.—The special data covered by this inquiry embrace details relative to assets and liabilities, together with the deficit or surplus. The difference between the deficit and surplus shows a net surplus for each geographic division and state.

Table 49 (p. 72) gives the assets and liabilities for commercial central stations, by geographic divisions and states.

Assets.—The $2,098,613,122 reported as the cost of construction, equipment, and real estate should not be considered as representing the value of properties which are engaged exclusively in the generation and distribution of electric current. In the case of the large hydroelectric station—the type which has had the greatest growth in the last five-year period, 1907 to 1912—many and varying conditions under which the stations are built and equipped must be given consideration. Often large tracts of land must be purchased, miles of riparian rights secured, large reservoirs built to secure a plentiful supply of water, and private rights of way acquired for the high-voltage lines; these and many other factors enter into the values shown by the figures in the table. Again, the franchise values, good will, intangible assets, etc., are often included, so that the actual cost of construction, equipment, and real estate is affected more or less according to the methods of bookkeeping employed by the reporting company. There were many different methods of bookkeeping shown in the balance sheets of the various companies reporting, but it is probable that a company would not underestimate the value of its properties or magnify the sum of its liabilities. The average cost per kilowatt capacity of dynamos of commercial stations in 1902 was $439 in 1907 it had decreased to $422, while in 1912 it had increased to $440—practically the same as 10 years before. The average cost per horsepower capacity of prime movers, which had decreased from $286 in 1902 to $279 in 1907, increased to $301 in 1912, a gain of $22 per initial horsepower in the latter five years.

The 3,659 companies whose financial condition is reflected in the balance sheet held as assets in 1912, stocks and bonds of companies other than electric to the value of $65,895,784, and of other electric companies to the value of $77,787,160, in addition to other permanent investments listed at $10,825,932. These combined holdings amounted to over 6 per cent of the total assets.

A number of companies hold as assets varying amounts of their own stock and bonds which may be carried as current assets or used as collateral for floating loans or for immediate delivery in case of sale. These are more or less a bookkeeping liability and represent a certain amount of duplication which should be deducted from the total invested to secure the net capitalization. The item of cash, current assets, and supplies was $140,138,589, and includes bills, notes, and accounts receivable, and represents the working capital of the companies. The total amount reported for the sinking and other special funds was $9,939,237.

Liabilities.—In addition to the $977,639,057 of common stock, $176,947,959 of preferred stock, and $897,907,681 of bonds issued, there was $12,165,075 reported as "cash" invested in central electric stations. This amount represents the cash capital of the 587 individuals, 293 firms, and seven other forms of ownership engaged in the generation of electric current. There were also a few cases of large corporations engaged in other branches of industry which, either from local pride or from sociological motives, furnished electric current for lighting small towns in the immediate neighborhood. The investment in electrical equipment in such cases was so small as compared with the whole establishment, that, for accounting purposes, it was carried as "cash investment" upon the books of the company. The item of $137,726,385, which is shown as floating debt, includes loans and notes, in addition to short-time securities floated for the purpose of construction, purchase of new equipment, etc. It forms 6.3 per cent of the aggregate amount of stock, funded debt, cash investment, and floating debt.

Notwithstanding the fact that the difference between the deficit and surplus results in a net surplus amounting to $115,671,116, for the commercial stations as a whole, that not all of these companies were successful financially is evidenced by the deficit shown of $7,409,621. In but few states, however, does the deficit form an appreciable part of the total.

Balance sheet, municipal stations.—Table 50 (p. 74) presents a balance sheet of municipal stations for the year ended December 31, 1912.

Many of the municipalities operating electric stations do not have systems of bookkeeping which are adapted to the uniform system of accounts generally employed by the commercial stations. The lighting plant is often operated not upon a separate basis but as one of the branches of the utilities of the municipality; and some other branch of the utilities may not only absorb the surplus and supply the deficit, but use the income, which often is not commensurate with the services rendered for various purposes, and may impose upon the electric plant, without adequate reimbursement, many expenses in the way of service.

Under these conditions the comparison of the cost of construction, equipment, and real estate with the funded debt, cash investments, and real estate mortgages has but little significance. The additions and betterments are often made by a special tax levy or a sum voted for the purpose out of the general receipts from taxation without any additional encumbrance being placed on the plant. With many of the stations the balance sheet is really a yearly statement rather than an accumulative summary of the financial condition.

DETAILED COMPARATIVE SUMMARY.

In the several tables of this report comparative statistics have been presented for the various features peculiar to the electric light and power industry, such as primary power, dynamo capacity, and line equipment, each subject being treated in a separate table. Table 55 (p. 82) brings together the principal facts in a detailed comparative summary, by geographic divisions and states, for 1912, 1907, and 1902.

COMMERCIAL CENTRAL ELECTRIC STATIONS—BALANCE

Table 49

	DIVISION AND STATE.	ASSETS.										
		Cost of construction, equipment, and real estate.	Stock and bonds of other electric companies.	Stock and bonds of companies other than electric.	Treasury securities.		Other permanent investments.	Cash and current assets, including supplies.	Stock and bond discount.	Sinking and other special funds.	Sundries.	Profit and loss deficit for companies showing a deficit.
					Stock.	Bonds.						
1	UNITED STATES	$2,098,613,122	$77,787,160	$65,895,784	$16,418,819	$32,099,639	$10,825,932	$140,138,589	$20,229,893	$9,939,237	$10,665,361	$7,409,621
	GEOGRAPHIC DIVISIONS:											
2	New England	147,947,181	2,769,854	5,076,669	479,202	413,507	688,661	11,582,678	173,714	593,362	1,006,191	143,463
3	Middle Atlantic	580,011,561	25,851,737	23,167,238	3,345,030	7,430,486	3,782,301	47,902,799	2,077,714	2,840,929	2,559,305	1,716,163
4	East North Central	357,102,214	3,924,608	7,574,629	4,330,426	8,006,267	1,518,117	25,590,642	2,380,046	1,130,978	1,349,152	2,705,922
5	West North Central	159,568,592	15,548,936	861,540	1,579,441	7,896,900	77,118	13,150,220	1,684,543	819,601	856,469	491,553
6	South Atlantic	127,176,089	6,137,901	4,312,349	501,550	740,119	577,760	7,475,162	659,112	600,087	173,117	778,670
7	East South Central	70,769,454	59,025	8,990	187,529	1,134,555	149,537	3,057,994	888,016	101,953	296,662	116,437
8	West South Central	71,991,145	451,013	18,000	166,997	144,004	72,548	3,637,253	559,794	156,297	635,264	370,587
9	Mountain	201,965,269	11,214,352	1,743,797	3,111,275	2,983,000	2,663,959	12,585,623	2,571,574	345,603	1,708,670	382,442
10	Pacific	382,081,617	11,829,734	23,132,572	2,717,369	3,350,801	1,295,931	15,156,218	9,235,380	3,350,427	2,080,531	704,384
	NEW ENGLAND:											
11	Maine	19,687,956	136,700	2,540,131	463,600	108,643	10,128	1,024,179	50,153	55,975	45,856	23,248
12	New Hampshire	17,905,032	2,222,026	3,425	3,500	32,981	138,005	836,059	64,768	84,244	176,707	18,953
13	Vermont	9,277,420	......	......	7,000	175,283	8,391	483,664	36,110	118,736	75,333	16,931
14	Massachusetts	68,395,610	......	301,388	......	......	201,334	5,963,643	......	246,374	594,407	70,250
15	Rhode Island	11,330,919	361,128	534,195	......	63,600	......	1,131,589	......	74,104	14,292	1,337
16	Connecticut	21,350,244	50,000	1,697,530	5,102	33,000	330,803	2,143,544	22,683	13,929	99,596	12,744
	MIDDLE ATLANTIC:											
17	New York	348,696,341	18,542,881	16,139,282	2,699,070	882,418	2,715,977	36,014,118	1,446,210	2,508,855	626,688	1,290,269
18	New Jersey	68,669,160	280,772	68,488	23,750	2,259,370	376,996	3,311,007	56,723	154,881	1,577,871	92,070
19	Pennsylvania	162,646,060	7,028,084	6,959,468	622,210	4,288,698	689,328	8,577,674	574,781	177,193	354,746	333,824
	EAST NORTH CENTRAL:											
20	Ohio	64,625,010	198,350	1,758,289	479,414	1,719,890	70,341	3,176,248	314,828	213,209	156,386	113,812
21	Indiana	43,747,700	17,088	184,456	1,680,502	3,268,850	51,131	2,836,320	774,621	42,262	169,090	195,003
22	Illinois	147,782,820	1,504,780	5,505,686	960,000	1,928,672	533,534	12,190,007	154,006	399,452	245,203	8,884
23	Michigan	66,285,610	144,100	55,030	68,435	147,800	214,603	4,932,454	938,907	157,439	571,267	2,076,938
24	Wisconsin	34,661,074	2,060,290	71,168	1,142,075	941,055	648,508	2,455,613	197,684	318,616	207,206	311,285
	WEST NORTH CENTRAL:											
25	Minnesota	41,767,683	10,461,780	15,416	18,750	3,442,500	......	3,935,332	378,541	403,331	46,462	66,869
26	Iowa	20,555,159	10,000	19,611	491,514	1,658,345	54,118	1,690,230	118,833	13,268	258,756	131,083
27	Missouri	46,350,586	781,196	393,136	2,500	409,583	15,000	4,572,167	819,000	30,902	176,136	123,410
28	North Dakota	4,598,964	3,025,700	14,700	......	1,314,700	......	340,285	119,875	82,630	1,212	......
29	South Dakota	10,985,158	......	114,693	218,818	163,000	1,000	442,441	49,440	19,812	220,730	28,617
30	Nebraska	11,565,718	166,726	27,912	146,859	538,772	......	589,092	47,911	266,658	28,591	70,733
31	Kansas	23,745,324	1,103,534	276,072	701,000	370,000	7,000	1,580,673	150,943	3,000	124,582	70,841
	SOUTH ATLANTIC:											
32	Delaware, District of Columbia, and Maryland.	39,527,113	1,703,952	1,375,575	8,300	428,649	156,718	2,442,026	400,031	455,967	73,080	93,350
33	Virginia	9,517,318	68,990	......	18,500	31,000	25,456	223,670	331	4,614	2,625	11,395
34	West Virginia	13,280,643	42,000	2,875	130,000	70,750	44,044	426,772	69,288	8,554	8,643	25,037
35	North Carolina	10,722,951	......	11,274	......	30,000	......	440,529	......	10,543	38,527	23,833
36	South Carolina	33,436,891	4,322,959	2,735,425	......	51,970	345,242	3,047,810	109,637	115,133	49,156	429,979
37	Georgia	18,344,251	......	185,000	......	52,750	6,300	728,243	62,400	5,276	1,014	129,265
38	Florida	2,346,922	......	2,200	344,750	75,000	......	166,112	17,425	......	72	65,811
	EAST SOUTH CENTRAL:											
39	Kentucky	19,025,541	......	......	4,929	1,020,825	500	710,745	565,000	85,964	39,613	52,156
40	Tennessee	39,953,142	......	1,110	32,600	14,230	......	1,568,238	68	3,773	119,339	25,758
41	Alabama	7,975,241	25,000	7,180	150,000	......	149,037	548,011	143,905	29	137,096	34,565
42	Mississippi	3,815,530	34,025	700	......	99,500	......	231,000	179,043	12,187	614	3,958
	WEST SOUTH CENTRAL:											
43	Arkansas	4,242,013	......	2,500	101,000	......	17,723	252,932	38,000	9,820	28,084	50,493
44	Louisiana	13,693,106	7,500	363	6,910	......	12,880	408,286	......	114,070	34,793	11,997
45	Oklahoma	11,697,726	423,513	7,350	3,831	143,654	5,321	637,444	251,035	27,921	195,981	132,433
46	Texas	42,358,300	20,000	7,787	55,256	350	36,624	2,338,591	270,759	4,486	376,406	175,664
	MOUNTAIN:											
47	Montana	64,441,739	2,000	1,379,846	35,425	73,000	2,334	7,546,623	980,420	56,327	67,608	16,985
48	Idaho	32,245,940	10,134,400	70,175	1,206,685	983,000	1,831,793	1,184,677	238,646	15,564	577,261	208,015
49	Wyoming	2,167,032	......	......	......	......	......	154,438	28,400	38,797	4,098	11,552
50	Colorado	66,709,390	854,322	263,382	1,711,632	1,507,000	352,846	2,234,277	569,438	121,589	309,218	110,716
51	New Mexico	3,070,644	149,502	1,155	15,077	125,000	358,564	170,960	50,000	......	21,281	22,036
52	Arizona	9,258,049	......	2,989	......	70,000	91,922	352,729	621,545	5,838	672,516	6,407
53	Utah	11,095,475	6,000	10,500	130,956	225,000	26,500	446,187	83,125	20,030	56,248	675
54	Nevada	12,977,000	68,128	15,750	11,500	......	......	495,732	......	87,458	440	6,056
	PACIFIC:											
55	Washington	16,316,527	394,700	10,225	368,920	166,426	151,539	1,015,679	351,609	6,094	33,546	126,135
56	Oregon	23,230,309	227,764	6,871	445,608	209,918	39,454	591,314	225,733	23,909	192,742	21,435
57	California	342,534,781	11,207,270	23,115,476	1,902,841	2,974,457	1,104,938	13,549,225	8,658,038	3,320,424	1,854,243	556,814

SHEET, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

Total—Assets or liabilities.	LIABILITIES.												Net surplus.	
	Capital stock.		Funded debt.	Cash investments.	Real estate mortgages.	Floating debt.	Reserves.	Accounts payable.	Interest and taxes due and accrued.	Dividends due.	Sundries.	Profit and loss surplus for companies showing a surplus.		
	Common.	Preferred.												
$2,490,023,157	$977,639,057	$176,947,959	$897,907,681	$12,165,075	$10,170,898	$137,726,385	$64,422,773	$40,936,406	$19,007,229	$3,214,790	$26,804,167	$123,080,737	$115,671,116	1
170,874,482	75,834,720	4,439,400	34,085,052	388,573	3,590,632	17,180,314	3,294,642	2,350,737	473,467	715,705	18,885,334	9,635,906	9,492,443	2
700,685,263	253,732,087	26,025,176	266,347,898	1,114,734	3,126,937	49,067,682	25,230,361	11,608,732	7,037,488	211,549	3,146,683	54,035,936	52,319,773	3
415,613,001	153,343,283	26,166,726	160,241,006	3,529,160	1,261,846	19,093,604	19,218,390	6,088,855	5,085,988	389,878	1,045,172	20,149,093	17,443,171	4
202,534,913	65,534,602	18,814,511	83,185,109	2,592,464	1,144,148	11,095,205	4,400,763	4,492,791	1,406,765	380,467	204,854	9,283,234	8,791,681	5
149,131,916	54,165,186	20,043,810	56,663,669	714,564	279,217	7,458,913	1,537,995	1,320,554	573,296	554,616	1,151,197	4,668,899	3,890,229	6
76,770,152	39,038,397	2,310,783	27,589,301	447,055	245,053	2,725,615	381,783	1,003,826	425,223	121,966	115,988	2,365,162	2,248,725	7
78,202,902	32,128,311	10,328,085	22,391,853	1,408,455	256,925	4,258,274	1,101,204	1,022,211	452,389	50,389	1,092,901	3,711,905	3,341,318	8
241,275,564	109,037,743	23,045,147	74,017,501	704,199	184,624	17,233,618	1,640,982	3,141,800	1,370,948	169,930	664,777	10,064,295	9,681,853	9
454,934,964	194,824,728	45,774,321	173,386,292	1,265,871	81,516	9,613,160	7,616,653	9,906,900	2,181,665	620,290	497,261	9,166,307	8,461,923	10
24,146,569	8,510,358	1,423,600	9,885,583	134,030	1,418,400	1,173,910	67,085	175,516	55,696	25,891	12,070	1,264,430	1,241,182	11
21,485,700	9,283,000	1,256,400	7,427,102	37,358	296,582	1,063,279	318,482	342,154	88,934	5,959	124,361	1,242,089	1,223,136	12
10,198,868	4,662,705	99,750	3,732,384	113,885	15,650	608,571	225,238	140,947	17,618	....	19,906	562,214	545,283	13
75,773,006	33,972,627	368,850	3,854,100	98,059	1,831,500	10,414,874	1,648,557	1,058,504	133,806	520,147	17,888,821	3,983,161	3,912,911	14
13,511,164	6,769,700	1,045,800	3,912,300	....	....	216,755	789,281	112,287	36,892	94,300	117,915	415,934	414,597	15
25,759,175	12,636,330	245,000	5,273,583	5,241	28,500	3,702,925	245,999	521,329	140,521	69,408	722,261	2,168,078	2,155,334	16
431,562,109	140,362,305	18,193,887	150,915,443	598,690	1,297,528	41,676,041	24,144,403	6,860,969	4,611,474	159,437	2,308,809	40,433,123	39,142,854	17
76,871,088	39,512,305	419,560	30,778,222	123,629	438,559	736,554	360,374	1,018,801	1,481,299	16,670	218,539	1,766,576	1,674,506	18
192,252,066	73,857,477	7,411,729	84,654,233	392,415	1,390,850	6,655,087	725,584	3,728,962	944,715	35,442	619,335	11,836,237	11,502,413	19
72,825,777	28,992,200	6,300,859	17,578,400	1,028,272	445,550	3,878,738	9,883,289	1,527,425	377,863	265,589	246,624	2,300,968	2,187,156	20
52,967,023	17,040,804	1,741,200	24,261,900	354,572	37,640	3,295,910	642,238	621,514	296,353	3,933	64,249	4,606,710	4,411,707	21
171,213,044	70,796,718	11,735,682	65,798,061	791,830	192,284	4,584,295	5,307,928	1,072,372	2,076,612	2,375	614,364	8,240,523	8,231,639	22
75,592,583	22,335,887	3,054,650	34,702,061	1,100,848	258,200	6,116,810	1,483,419	1,673,870	1,862,352	19,366	91,541	2,893,579	816,641	23
43,014,574	14,177,674	3,334,335	17,900,584	253,638	328,172	1,217,851	1,901,516	1,193,674	472,808	98,615	28,394	2,107,313	1,796,028	24
60,536,664	14,806,119	7,507,000	28,771,483	392,619	325,500	4,420,924	954,456	666,532	530,664	159,700	27,520	1,974,147	1,907,278	25
25,000,917	9,462,131	1,451,853	9,799,321	592,774	121,629	1,341,568	157,723	414,936	141,222	55,799	58,480	1,403,481	1,272,398	26
53,673,616	17,481,761	1,415,070	23,246,160	345,527	149,500	1,422,558	2,750,603	2,567,462	388,842	100,368	51,682	3,754,083	3,630,673	27
9,498,066	2,040,000	2,019,900	3,371,700	205,450	77,800	1,312,853	50,618	42,128	44,333	33,057	82	300,145	300,145	28
12,243,709	5,340,310	1,198,600	4,108,144	141,318	273,500	490,146	88,335	161,673	99,124	2,524	12,526	327,509	298,892	29
13,448,972	6,325,977	669,838	4,171,151	374,470	44,785	689,136	89,630	181,365	81,401	510	29,611	791,098	720,365	30
28,132,969	10,078,304	4,552,250	9,717,150	540,306	151,434	1,418,020	309,398	458,695	121,179	28,509	24,953	732,771	661,930	31
46,664,761	14,037,170	4,192,024	23,755,200	129,705	83,550	1,601,396	960,530	405,894	171,409	43,878	6,182	1,277,823	1,184,473	32
9,903,899	4,100,306	1,129,663	3,405,625	118,331	19,000	807,882	3,962	145,596	32,212	1,406	964	138,952	127,557	33
14,108,606	6,078,571	1,089,337	5,173,957	81,575	10,000	995,169	93,274	215,009	34,075	3,500	996	333,143	308,106	34
11,277,657	5,260,350	125,500	4,616,632	147,600	3,500	502,753	87,194	118,778	7,915	72,740	4,454	330,241	306,408	35
44,644,202	15,601,572	13,104,300	10,975,957	77,620	45,000	1,723,646	353,035	199,079	137,173	432,158	51,804	1,942,858	1,512,879	36
19,514,499	7,752,100	372,986	8,120,805	107,279	20,000	1,298,767	40,000	139,513	187,416	794	1,084,878	389,961	260,696	37
3,018,292	1,335,117	30,000	615,493	52,454	98,167	529,300	....	96,685	3,096	140	1,919	255,921	190,110	38
21,505,273	8,557,069	860,333	8,944,500	112,885	101,933	1,429,686	226,548	332,496	170,235	67,409	60,001	642,178	590,022	39
41,718,258	25,828,823	190,000	13,322,894	161,321	24,800	407,752	92,371	438,369	166,924	40,578	1,843	1,042,583	1,016,825	40
9,170,064	2,916,433	852,500	3,769,917	137,481	13,600	669,111	52,161	171,454	54,530	9,946	40,739	482,192	447,627	41
4,376,557	1,736,072	407,950	1,551,990	35,368	104,720	219,066	10,703	61,507	33,534	4,033	13,405	198,209	194,251	42
4,742,565	1,618,722	166,890	1,549,406	473,540	29,731	276,368	67,789	73,217	19,113	3,000	170,003	294,786	244,293	43
14,289,905	3,276,320	3,374,653	5,167,487	30,857	67,176	914,155	342,194	154,018	150,482	20,811	313,318	478,434	466,437	44
13,526,209	5,456,700	1,112,375	5,208,882	150,791	43,550	613,160	76,639	197,887	111,952	22,995	83,656	447,622	315,189	45
45,644,223	21,776,569	5,674,167	10,466,078	753,267	116,468	2,454,591	614,582	597,089	170,842	3,583	525,924	2,491,063	2,315,399	46
74,602,307	39,529,391	5,119,240	21,714,533	203,000	55,000	4,424,853	489,981	612,493	344,315	13,648	3,853	2,092,000	2,075,015	47
48,696,156	23,123,232	5,364,600	15,901,499	53,000	27,000	1,108,056	109,373	1,612,493	219,287	112,178	14,370	1,051,068	843,053	48
2,404,317	957,460	145,000	821,000	55,801	10,000	119,415	15,766	85,404	18,987	4,000	8,037	163,447	151,895	49
74,743,810	28,603,993	10,912,740	26,331,575	117,208	62,124	3,115,551	306,129	331,012	661,196	28,746	108,720	4,164,816	4,054,100	50
3,984,219	1,617,900	13,000	1,489,000	....	9,500	434,547	68,660	70,713	18,397	....	1,578	260,924	238,888	51
11,081,995	4,937,684	1,490,567	3,452,034	190,338	....	241,100	181,199	132,542	18,529	10,120	32,037	395,845	389,438	52
12,100,696	5,956,858	....	3,526,860	84,852	21,000	849,577	372,512	258,150	73,943	1,238	17,671	938,035	937,360	53
13,662,064	4,311,225	....	781,000	....	....	6,940,519	97,362	38,993	16,294	....	478,511	998,160	992,104	54
18,941,400	7,872,053	2,831,400	6,558,303	270,178	31,050	501,748	35,031	273,788	155,156	680	18,619	393,394	267,259	55
25,215,057	12,261,703	2,454,800	8,756,419	65,528	16,000	329,814	27,929	595,316	128,581	....	173,386	405,581	384,146	56
410,778,507	174,690,972	40,488,121	158,071,570	930,165	34,466	8,781,598	7,553,693	9,037,796	1,897,928	619,610	305,256	8,367,332	7,810,518	57

MUNICIPAL CENTRAL ELECTRIC STATIONS—BALANCE

	Table 50	ASSETS.							
	DIVISION AND STATE.	Cost of construction, equipment, and real estate.	Other permanent investments.	Cash and current assets, including supplies.	Stock and bond discount.	Sinking and other special funds.	Sundries.	Profit and loss deficit for stations showing a deficit.	Total—Assets or liabilities.
1	UNITED STATES	$77,065,144	$41,336	$5,381,152	$18,432	$1,659,098	$1,907,100	$448,863	$86,521,125
	GEOGRAPHIC DIVISIONS:								
2	New England	5,521,077	9,506	537,841		360,642	68,768	248,118	6,745,952
3	Middle Atlantic	4,095,800		254,779	130	47,422	7,624	3,074	4,408,829
4	East North Central	31,473,659	7,830	1,584,067	42	418,957	1,759,389	44,343	35,288,287
5	West North Central	10,738,343	24,000	826,373	10,550	61,876	48,870	60,754	11,770,766
6	South Atlantic	7,134,097		570,190	6,005	589,619	5,189	7,810	8,312,910
7	East South Central	4,195,120		112,886	1,705	17,318	3,978	34,942	4,365,949
8	West South Central	4,061,629		87,239		36,334	6,927	9,777	4,201,906
9	Mountain	1,230,529		103,816		13,706	2,637	6,000	1,356,688
10	Pacific	8,614,890		1,303,961		113,224	3,718	34,045	10,069,838
	NEW ENGLAND:								
11	Maine	238,336		6,241		1,544			246,121
12	New Hampshire	156,544		3,339		19,500			179,383
13	Vermont	750,180	9,506	69,817		10,542	8,000	5,100	853,145
14	Massachusetts	3,311,628		416,752		296,056	60,768	243,018	4,328,222
15	Rhode Island	8,375		2,300					10,675
16	Connecticut	1,056,014		39,392		33,000			1,128,406
	MIDDLE ATLANTIC:								
17	New York	1,830,563		211,940		3,769	2,624	3,074	2,051,970
18	New Jersey	389,221		4,985		25,436			419,642
19	Pennsylvania	1,876,016		37,854	130	18,217	5,000		1,937,217
	EAST NORTH CENTRAL:								
20	Ohio	4,618,884		216,534		286,311	4,536	5,138	5,131,403
21	Indiana	4,182,552	7,680	286,547		28,856	75	2,897	4,508,607
22	Illinois	14,321,406		408,131		60,023	1,733,780	857	16,524,197
23	Michigan	6,479,220	150	503,287		24,731	13,780	15,701	7,036,869
24	Wisconsin	1,871,597		169,568	42	19,036	7,218	19,750	2,087,211
	WEST NORTH CENTRAL:								
25	Minnesota	2,593,227		299,483		2,885	1,380	32,941	2,929,916
26	Iowa	1,571,359		184,934		4,147	2,650	11,324	1,774,414
27	Missouri	2,274,124	4,000	87,515	10,000	41,463	43,650	2,745	2,463,497
28	North Dakota	282,668		28,269		2,000			312,937
29	South Dakota	332,883		24,453					357,336
30	Nebraska	1,405,598	20,000	107,665		6,071	1,190	4,512	1,545,036
31	Kansas	2,278,484		94,054	550	5,310		9,232	2,387,630
	SOUTH ATLANTIC:								
32	Delaware, District of Columbia, and Maryland	443,309		13,201		4,320			460,830
33	Virginia	1,410,061		11,550		1,070			1,422,681
34	West Virginia	109,530		2,322		810	190		112,852
35	North Carolina	1,367,289		91,299	2,500	3,900	3,049		1,468,028
36	South Carolina	575,477		51,602	3,505		1,800	2,579	634,963
37	Georgia	1,546,674		188,328		6,394	150	4,764	1,746,310
38	Florida	1,681,766		211,888		573,125		467	2,467,246
	EAST SOUTH CENTRAL:								
39	Kentucky	683,482		13,241		1,318		9,790	707,831
40	Tennessee	1,564,274		46,380	102	15,500	35	2,500	1,628,791
41	Alabama	751,535		12,898	1,603		3,943	19,199	789,178
42	Mississippi	1,195,829		40,367		500		3,453	1,240,149
	WEST SOUTH CENTRAL:								
43	Arkansas	569,866		12,342		4,000	6,927	25	593,160
44	Louisiana	582,163		17,466		1,057			600,686
45	Oklahoma	1,654,914		38,154		10,302		9,707	1,713,077
46	Texas	1,254,686		19,277		20,975		45	1,294,983
	MOUNTAIN:								
47	Montana	141,652		22,121					163,773
48	Idaho	236,626		11,050					247,676
49	Wyoming	33,000							33,000
50	Colorado	279,752		27,900				1,500	309,152
51	New Mexico	63,116		5,874			45	4,500	73,535
52	Utah	460,021		36,852		13,706	2,592		513,171
53	Nevada	16,362		19					16,381
	PACIFIC:								
54	Washington	6,194,001		1,142,055		56,720	1,527	34,045	7,428,348
55	Oregon	566,438		14,767		6,307			587,512
56	California	1,854,451		147,139		50,197	2,191		2,053,978

SHEET, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

LIABILITIES.										
Funded debt.	Cash investments.	Real estate mortgages.	Floating debt.	Reserves.	Accounts payable.	Interest and taxes due and accrued.	Sundries.	Profit and loss surplus for stations showing a surplus.	Net surplus.	
$31,189,357	$27,064,963	$344,608	$4,959,382	$2,509,652	$1,347,263	$723,087	$235,728	$18,147,085	$17,698,222	1
2,844,716	1,480,678	266,666	678,350	186,876	73,946	18,602	161,906	1,034,212	786,094	2
2,048,491	723,714	......	85,463	167,879	30,118	5,214	16,568	1,331,382	1,328,308	3
7,141,321	18,000,729	1,150	2,803,312	1,048,969	235,431	650,720	23,715	5,382,940	5,338,597	4
5,312,801	2,236,522	41,000	322,308	128,870	204,932	13,824	15,322	3,495,187	3,434,433	5
3,966,415	1,025,604	24,150	200,751	4,603	332,245	4,623	6,925	2,747,594	2,739,784	6
2,188,741	1,543,408	6,667	204,099	14,000	57,333	4,218	600	346,883	311,941	7
2,246,529	913,648	4,975	218,071	600	35,093	8,228	5,032	769,730	759,953	8
675,811	196,752	......	63,300	13,313	17,005	753	4,922	384,832	378,832	9
4,764,532	943,908	......	383,728	944,542	361,160	16,905	738	2,654,325	2,620,280	10
48,500	161,500	......	......	......	169	......	......	35,952	35,952	11
115,000	38,968	......	7,113	......	11,836	1,032	......	5,434	5,434	12
541,900	40,000	......	96,933	22,419	5,384	......	16,000	130,509	125,409	13
1,782,742	1,235,210	......	520,304	116,841	50,581	17,410	145,906	459,228	216,210	14
......	......	......	7,000	......	400	......	......	3,275	3,275	15
356,574	5,000	266,666	47,000	47,616	5,576	160	......	399,814	399,814	16
765,980	229,776	......	55,661	157,443	20,919	4,014	16,568	801,609	798,535	17
164,663	185,275	......	......	10,436	1,291	......	......	57,977	57,977	18
1,117,848	308,663	......	29,802	......	7,908	1,200	......	471,796	471,796	19
2,533,520	2,220,809	......	8,880	24,644	85,375	4,043	15,419	238,713	233,575	20
641,239	2,836,920	400	58,854	32,259	27,293	960	1,191	909,491	906,594	21
585,905	10,483,525	......	2,584,485	796,902	36,375	629,169	......	1,407,836	1,406,979	22
2,496,601	1,837,098	750	52,035	90,645	52,074	7,291	2,120	2,498,255	2,482,554	23
884,056	622,377	......	99,058	104,519	34,314	9,257	4,985	328,645	308,895	24
1,091,336	887,845	......	126,455	24,662	58,107	5,619	......	735,892	702,951	25
509,789	317,412	......	43,520	69,982	26,087	300	3,900	803,424	792,100	26
1,268,000	171,565	32,500	25,700	10,097	61,322	719	......	893,594	890,849	27
120,300	55,000	......	15,013	6,905	13,980	281	......	101,458	101,458	28
104,315	88,637	......	2,940	15,184	6,652	2,500	......	137,108	137,108	29
634,333	459,123	8,500	48,238	......	12,077	404	1,422	380,939	376,427	30
1,584,728	256,940	......	60,442	2,040	26,707	4,001	10,000	442,772	433,540	31
231,500	63,829	18,000	16,800	......	13,769	......	......	116,932	116,932	32
1,030,324	23,000	......	77,158	......	1,600	......	......	290,599	290,599	33
28,700	72,670	......	......	......	......	......	......	11,482	11,482	34
845,888	447,549	......	64,000	......	18,656	10	......	91,925	91,925	35
398,900	70,012	6,150	7,155	1,174	7,894	1,200	484	141,994	139,415	36
1,078,280	124,006	......	29,870	2,629	46,433	1,139	......	463,953	459,189	37
352,823	224,538	......	5,768	800	243,893	2,274	6,441	1,630,709	1,630,242	38
72,400	541,259	......	15,842	......	18,450	1,000	......	58,880	49,090	39
828,600	640,841	......	12,857	14,000	19,760	118	......	112,615	110,115	40
467,500	92,217	6,667	162,000	......	9,092	3,100	600	48,002	28,803	41
820,241	269,091	......	13,400	......	10,031	......	......	127,386	123,933	42
191,929	83,100	......	63,270	......	9,589	900	260	244,112	244,087	43
91,800	166,419	......	79,546	600	8,312	300	......	253,709	253,709	44
1,448,800	80,278	......	24,105	......	10,922	6,600	4,772	137,600	127,893	45
514,000	583,851	4,975	51,150	......	6,270	428	......	134,309	134,264	46
41,000	......	......	......	13,313	4,137	......	......	105,323	105,323	47
170,000	19,430	......	......	......	......	......	......	58,246	58,246	48
......	30,000	......	......	......	......	......	......	3,000	3,000	49
126,925	108,002	......	37,200	......	6,744	453	3,750	26,078	24,578	50
51,700	......	......	5,500	......	820	......	......	15,515	11,015	51
271,186	39,320	......	20,600	......	5,304	300	1,172	175,289	175,289	52
15,000	......	......	......	......	......	......	......	1,381	1,381	53
3,683,200	838,003	......	236,234	725,805	303,741	14,150	738	1,626,477	1,592,432	54
443,500	6,700	......	57,971	......	......	......	......	79,341	79,341	55
637,832	99,205	......	89,523	218,737	57,419	2,755	......	948,507	948,507	56

CHAPTER VII.

EMPLOYEES, SALARIES, AND WAGES.

Character of the statistics.—Each census has obtained statistics of the number of salaried employees and wage earners and the amounts paid in salaries and wages during the year. The schedules used at the censuses of 1902 and 1907 called for the average number employed during the year. Three classes of salaried employees were reported separately in 1907: Salaried officers of corporations; other officers (general managers, superintendents, electricians, and experts); clerks and bookkeepers. Separate data were also required for four classes of wage earners: Foremen; inspectors; engineers; and all other employees (including firemen, dynamo and switchboard men, linemen, mechanics, and lamp trimmers).

To compute the correct average number employed during the year, it would be necessary to consider the number employed each day. In 1907 many of the larger stations contended that it was impracticable to compute such an average, and therefore reported the number employed under normal conditions. It also developed that in many stations the same employees performed the duties covered by two or more of the separate classes of employees. In fact, in each of the smaller stations two or three persons did all of the work, and it was impossible to assign them to distinctive classes. In view of these conditions it was thought best to simplify the inquiries, and the schedule for 1912 called for the number employed on September 16 of that year, or if data were not available for that day, for the number employed on the nearest representative or normal day. Separate figures were required for three classes of salaried employees: Salaried officers of corporations; superintendents and managers; clerks, stenographers, and other salaried employees. The wage earners were not reported by classes.

The change in the form of the inquiry had some effect on the numbers reported for the different classes at the census of 1912, as compared with prior censuses. It probably resulted in a larger number being assigned to the class of clerks and other salaried employees. For example, it may be that for some stations foremen, inspectors, and engineers who were specified as wage earners in the schedules of 1902 and 1907 were considered salaried employees in 1912 and reported as such. The comparability of the statistics is also affected to some extent by the method of reporting employees in the small composite and municipal stations where the employees devote only a part of their time to central station work. In some instances the entire number of such employees was reported, and in others only a portion of the number, depending upon the time employed in the central station or the system of bookkeeping used.

The effect of these various conditions on the comparability of the statistics, while noticeable, varies considerably in the several states. It is believed, however, that the average number reported for preceding censuses is fairly comparable with the number for a given date or normal day in 1912, but in view of the conditions named it is thought best to limit the detail comparisons with 1902 and 1907 to the totals for the United States, which are given in Table 51.

A comparison of the total number of employees and the total salaries and wages paid, for 1912, 1907, and 1902, by geographic divisions and states, is given in Table 52.

COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—EMPLOYEES, SALARIES, AND WAGES: 1912, 1907, AND 1902.

Table 51

CLASS.	TOTAL.			COMMERCIAL.			MUNICIPAL.			PER CENT OF INCREASE: 1902-1912.		
	1912	1907	1902	1912	1907	1902	1912	1907	1902	Total.	Commercial.	Municipal.
Total:												
Number	79,335	47,632	30,326	71,395	42,066	26,909	7,940	5,566	3,417	161.6	165.3	132.4
Salaries and wages	$61,161,941	$35,420,324	$20,646,692	$55,658,515	$31,935,309	$18,766,970	$5,503,426	$3,485,015	$1,879,722	196.2	196.6	192.8
Salaried employees:												
Officers of corporations—												
Number	2,181	1,761	1,416	2,181	1,761	1,416	....	....	....	54.0	54.0	....
Salaries	$3,839,136	$2,202,028	$1,465,471	$3,839,136	$2,202,028	$1,465,471	....	....	....	162.0	162.0	....
Superintendents and managers—												
Number	4,792	4,357	2,564	3,629	3,268	1,875	1,163	1,089	689	86.9	93.5	68.8
Salaries	$6,482,749	$5,058,236	$2,481,278	$5,397,004	$4,243,307	$2,088,298	$1,085,745	$814,929	$392,980	161.3	158.4	176.3
Clerks, stenographers, and other salaried employees—												
Number	19,120	6,872	3,016	18,067	6,346	2,755	1,053	526	261	534.0	555.8	319.5
Salaries	$13,985,419	$4,473,523	$1,716,831	$13,400,937	$4,293,620	$1,652,430	$584,482	$179,903	$64,401	714.6	711.0	807.6
Wage earners:												
Average number	[1] 53,242	34,642	23,330	[1] 47,518	30,691	20,863	[1] 5,724	3,951	2,467	128.2	127.8	132.0
Wages	$36,854,637	$23,686,537	$14,983,112	$33,021,438	$21,196,354	$13,560,771	$3,833,199	$2,490,183	$1,422,341	146.0	143.5	169.5

[1] Number Sept. 16, or nearest representative day.

CENTRAL ELECTRIC STATIONS—TOTAL NUMBER OF EMPLOYEES AND SALARIES AND WAGES, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902.

Table 52

DIVISION AND STATE.	1912		1907		1902		PER CENT OF INCREASE.[1]					
							1902–1912		1907–1912		1902–1907	
	Number.	Salaries and wages.	Number.	Salaries and wages.	Number.	Salaries and wages.	Number.	Salaries and wages.	Number.	Salaries and wages.	Number.	Salaries and wages.
UNITED STATES	79,335	$61,161,941	47,632	$35,420,324	30,326	$20,646,692	161.6	196.2	66.6	72.7	57.1	71.6
GEOGRAPHIC DIVISIONS:												
New England	7,352	5,604,983	5,088	3,899,439	3,673	2,680,627	100.2	109.1	44.5	43.7	38.5	45.5
Middle Atlantic	24,022	18,612,382	13,977	10,431,544	9,675	6,821,860	148.3	172.8	71.9	78.4	44.5	52.9
East North Central	19,233	14,085,033	10,324	7,213,771	6,866	4,260,583	180.1	230.6	86.3	95.3	50.4	69.3
West North Central	7,892	5,875,467	5,007	3,538,044	3,067	1,946,600	157.3	201.8	57.6	66.1	63.3	81.8
South Atlantic	4,317	2,780,706	2,622	1,692,982	1,537	799,317	180.9	247.9	64.6	64.2	70.6	111.8
East South Central	2,426	1,641,770	1,632	919,524	1,017	563,828	138.5	191.2	48.7	78.5	60.5	63.1
West South Central	3,655	2,543,847	2,474	1,594,619	1,350	887,919	170.7	186.5	47.7	59.5	83.3	79.6
Mountain	3,090	2,927,122	2,028	1,819,343	1,320	1,123,285	134.1	160.6	52.4	60.9	53.6	62.0
Pacific	7,348	7,090,631	4,480	4,311,058	1,821	1,562,673	303.5	353.8	64.0	64.5	146.0	175.9
NEW ENGLAND:												
Maine	629	402,394	502	308,006	340	202,726	85.0	98.5	25.3	30.6	47.6	51.9
New Hampshire	578	434,617	422	286,749	294	187,933	96.6	131.3	37.0	51.6	43.5	52.6
Vermont	340	219,897	297	188,780	242	132,645	40.5	65.8	14.5	16.5	22.7	42.3
Massachusetts	3,954	2,981,043	2,672	2,235,647	2,024	1,588,836	95.4	87.6	48.0	33.3	32.0	40.7
Rhode Island	511	512,771	450	350,605	274	238,724	86.5	114.8	13.6	46.3	64.2	46.9
Connecticut	1,340	1,054,261	745	529,652	499	329,763	168.5	219.7	79.9	99.0	49.3	60.6
MIDDLE ATLANTIC:												
New York	13,733	11,034,898	7,716	5,819,617	5,421	3,904,706	153.3	182.6	78.0	89.6	42.3	49.0
New Jersey	2,989	2,479,219	1,759	1,370,506	1,074	821,739	178.3	201.7	69.9	80.9	63.8	66.8
Pennsylvania	7,300	5,098,265	4,502	3,241,421	3,180	2,095,415	129.6	143.3	62.2	57.3	41.6	54.7
EAST NORTH CENTRAL:												
Ohio	3,131	2,264,892	2,157	1,543,925	1,766	1,053,991	77.3	114.9	45.2	46.7	22.1	46.5
Indiana	2,269	1,525,875	1,618	969,263	941	549,428	141.1	177.7	40.2	57.4	71.9	76.4
Illinois	8,036	6,223,882	3,902	3,032,721	2,339	1,603,904	243.6	288.0	105.9	105.2	66.8	89.1
Michigan	3,876	2,843,371	1,780	1,126,813	1,255	728,952	208.8	290.1	117.8	152.3	41.8	54.6
Wisconsin	1,921	1,227,013	867	541,049	565	324,308	240.0	278.3	121.6	126.8	53.5	66.8
WEST NORTH CENTRAL:												
Minnesota	1,568	1,222,493	1,062	755,778	649	433,256	141.6	182.2	47.6	61.8	63.6	74.4
Iowa	1,329	921,096	855	547,177	732	406,819	81.6	126.4	55.4	68.3	16.8	34.5
Missouri	2,434	1,883,844	1,800	1,306,640	997	684,197	144.1	175.3	35.2	44.2	80.5	91.0
North Dakota	232	197,983	150	113,383	75	47,260	209.3	318.9	54.7	74.6	100.0	139.9
South Dakota	338	264,159	169	127,143	85	58,116	297.6	354.5	100.0	107.8	98.8	118.8
Nebraska	882	598,703	404	313,427	237	149,190	272.2	301.3	118.3	91.0	70.5	110.1
Kansas	1,109	787,189	567	374,496	292	167,762	279.8	369.2	95.6	110.2	94.2	123.2
SOUTH ATLANTIC:												
Delaware, Maryland, and District of Columbia	1,249	936,805	1,024	759,508	549	326,599	127.5	186.8	22.0	23.3	86.5	132.6
Virginia	341	170,884	178	99,060	170	68,249	100.6	150.4	91.6	72.5	4.7	45.1
West Virginia	439	255,471	262	168,633	178	95,343	146.6	167.9	67.6	51.5	47.2	76.9
North Carolina	453	261,078	248	131,013	141	67,996	221.3	284.0	82.7	99.3	75.9	92.7
South Carolina	683	452,456	261	145,357	160	75,642	326.9	498.2	161.7	211.3	63.1	92.2
Georgia	697	417,959	384	232,711	203	92,173	243.3	353.4	81.5	79.6	89.2	152.5
Florida	455	286,053	265	156,700	136	73,315	234.6	290.2	71.7	82.5	94.9	113.7
EAST SOUTH CENTRAL:												
Kentucky	907	635,829	585	301,794	367	216,438	147.1	193.8	55.0	110.7	59.4	39.4
Tennessee	656	455,212	416	247,764	306	165,041	114.4	175.8	57.7	83.7	35.9	50.1
Alabama	456	286,936	343	208,533	162	87,049	181.5	229.6	32.9	37.6	111.7	139.6
Mississippi	407	263,793	288	161,433	182	95,300	123.6	176.8	41.3	63.4	58.2	69.4
WEST SOUTH CENTRAL:												
Arkansas	360	242,267	244	157,814	149	90,759	141.6	166.9	47.5	53.5	63.8	73.9
Louisiana	489	371,034	541	382,982	336	226,050	45.5	64.1	−9.6	−3.1	61.0	69.4
Oklahoma	785	581,580	414	264,604	92	61,929	753.3	839.1	89.6	119.8	350.0	327.3
Texas	2,021	1,348,966	1,275	789,219	773	509,181	161.4	164.9	58.5	70.9	64.9	55.0
MOUNTAIN:												
Montana	514	625,918	319	360,768	202	218,302	154.5	186.7	61.1	73.5	57.9	65.3
Idaho	324	334,063	188	171,125	88	66,719	268.2	400.7	72.3	95.2	113.6	156.5
Wyoming	163	149,356	96	77,811	53	46,125	207.5	223.8	69.8	91.9	81.1	68.7
Colorado	1,166	999,864	918	775,045	588	482,588	98.3	107.2	27.0	29.0	56.1	60.6
New Mexico	158	119,088	83	66,981	45	34,740	251.1	242.8	90.4	77.8	84.4	92.8
Arizona	217	219,798	148	130,663	86	82,644	152.3	166.0	46.6	68.2	72.1	58.1
Utah	401	365,399	198	159,686	240	177,391	67.1	106.0	102.5	128.8	−17.5	−10.0
Nevada	147	113,636	78	77,264	18	14,776	716.7	669.1	88.5	47.1	333.3	422.9
PACIFIC:												
Washington	1,078	880,309	885	800,441	274	218,177	293.4	303.5	21.8	10.0	223.0	266.9
Oregon	532	387,119	467	416,424	187	167,755	184.5	130.8	13.9	−7.0	149.7	148.2
California	5,738	5,823,203	3,128	3,094,193	1,360	1,176,741	321.9	394.9	83.4	88.2	130.0	162.9

[1] A minus sign (−) denotes decrease.

The employees represent those engaged in the operation and maintenance of the plants, including those employed in making ordinary repairs and replacements. It is probable that the regular employees in some stations were engaged in making additions to the plants and in new construction. In such cases it was impossible to segregate the data, and therefore the total numbers were included in the census report. As a rule, however, the numbers of persons employed on addition and extension work were not so included.

As shown in Table 51 on the preceding page, the central electric light and power stations of the country gave employment to 79,335 persons in 1912, as compared with 30,326 in 1902, there having been an increase of 161.6 per cent during the decade. During the same time the amount paid annually in salaries and wages increased by 196.2 per cent.

Of the total number reported for 1912, 26,093, or 32.9 per cent, were included in the class of salaried employees, and their salaries amounted to $24,307,304, forming 39.7 per cent of the total annual salaries and wages. The number of wage earners formed 67.1 per cent of the total number of employees, and their wages 60.3 per cent of the annual salary and wage account. In 1912 the commercial stations of the country gave employment to 90 per cent of the total number of salaried persons and wage earners engaged in the industry.

There were, of course, no officers of corporations to be reported for municipal stations. There were, in 1912, however, 2,216 salaried employees reported, this number forming 27.9 per cent of the total for such stations. Their salaries amounted to $1,670,227, or 30.3 per cent of the total amount paid in salaries and wages by this class of stations.

Considering the total number of stations of all classes reported for 1912, the average number of persons employed in each was 15.2, as compared with 10.1 for 1907 and 8.4 for 1902. The constant increase in the average number of employees per station is another indication of the increase in the average size of the station.

Table 52 shows that for the decade 1902–1912 the percentages of increase both in number of employees and in salaries and wages were conspicuously the largest for the Pacific division, while the smallest percentages of increase in these items are shown for the New England division. The actual increases, however, were greatest for the Middle Atlantic division.

For each of the nine divisions the percentage of increase during the decade was greater for salaries and wages than for number of employees. This condition prevailed also in all but four states.

Exceptionally large percentages of increase are shown for Oklahoma and Nevada, but the totals for these states are small, and the industry in 1902 was comparatively insignificant. The smallest percentage of increase in number of employees during the decade is shown for Vermont, while the smallest proportionate gain in salaries and wages was made by Louisiana. As already explained in another chapter, the totals for central stations in Louisiana have been diminished by the transfer of ownership since 1902 of large central stations to electric railways.

The total output of central electric stations and the average per employee, in kilowatt hours, as reported at the censuses of 1912, 1907, and 1902, are given in Table 53.

There was a much more rapid increase in the total kilowatt-hour output of the stations than in the total number of employees. While the data for the output of the stations reported for 1907 and 1902 are probably more defective than those for 1912, nevertheless they are sufficiently correct to use for general comparative purposes. The average output per employee for 1912 was 145,370 kilowatt hours, as compared with 123,074 for 1907 and 82,670 for 1902. The average output per employee for the hydroelectric stations, for which separate statistics are given in Table 20, was 341,457 kilowatt hours for 1912, as compared with 91,252 for all other stations reported at that census. A similar comparison can not be made for preceding censuses, but it is fair to presume that the output per employee for the hydroelectric stations was much greater than that for any other class.

Table 53 OUTPUT OF CENTRAL ELECTRIC STATIONS AND AVERAGE OUTPUT PER EMPLOYEE, BY GEOGRAPHIC DIVISIONS: 1912, 1907, AND 1902.

DIVISION.[1]	Census.	Total number of persons employed.	Output of stations.	
			Total kilowatt hours.	Average per employee.
United States	1912	79,335	11,532,963,006	145,370
	1907	47,632	5,862,276,737	123,074
	1902	30,326	2,507,051,115	82,670
New England	1912	7,352	879,272,535	119,596
	1907	5,088	473,802,067	93,121
	1902	3,673	247,727,501	67,446
Middle Atlantic	1912	24,022	3,548,605,305	147,723
	1907	13,977	2,009,304,160	143,758
	1902	9,675	1,021,603,500	105,592
East North Central	1912	19,233	2,527,964,097	131,439
	1907	10,324	1,075,933,354	104,217
	1902	6,866	475,097,910	69,196
West North Central	1912	7,892	712,595,442	90,293
	1907	5,007	386,180,647	77,128
	1902	3,067	169,964,203	55,417
South Atlantic	1912	4,317	679,856,425	157,484
	1907	2,622	266,437,175	101,616
	1902	1,537	102,990,575	67,008
East South Central	1912	2,426	227,664,808	93,844
	1907	1,632	118,631,967	72,691
	1902	1,017	73,750,879	72,518
West South Central	1912	3,655	233,947,656	64,008
	1907	2,474	138,755,643	56,086
	1902	1,350	80,154,471	59,374
Mountain	1912	3,090	845,393,882	273,590
	1907	2,028	381,032,187	187,886
	1902	1,320	145,780,112	110,439
Pacific	1912	7,348	1,877,662,856	255,534
	1907	4,480	1,012,199,537	225,937
	1902	1,821	189,981,964	104,328

[1] See page 25 for states composing the several geographic divisions.

Among the several geographic divisions the largest averages per employee are found for the Mountain and the Pacific states. These two divisions also show very large percentages of increase per employee. The largest actual increase during the decade for any division in the average per employee, 163,151 kilowatt hours, and the largest percentage of increase, 147.7, are shown for the Mountain division. The Pacific and South Atlantic states follow in both respects, in the order named. It is significant that in each of these three divisions water is the predominating primary power.

Table 54 gives, for each of the several classes of employees as called for in the schedule used in 1912, their number and their salaries or wages, by geographic divisions and states.

CENTRAL ELECTRIC STATIONS—EMPLOYEES AND SALARIES AND WAGES, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

Table 54 DIVISION AND STATE.	AGGREGATE.		SALARIED EMPLOYEES.								WAGE EARNERS.	
			Total.		Officers of corporations.		Superintendents and managers.		Clerks, stenographers, and other salaried employees.			
	Number.	Salaries and wages.	Number.	Salaries.	Number.	Salaries.	Number.	Salaries.	Number.	Salaries.	Number.	Wages.
United States	79,335	$61,161,941	26,093	$24,307,304	2,181	$3,839,136	4,792	$6,482,749	19,120	$13,985,419	53,242	$36,854,637
Geographic divisions:												
New England	7,352	5,604,983	1,952	1,873,727	335	471,626	389	631,733	1,228	770,368	5,400	3,731,256
Middle Atlantic	24,022	18,612,382	7,467	7,004,263	527	999,610	890	1,476,179	6,050	4,528,474	16,555	11,608,119
East North Central	19,233	14,085,033	6,921	5,819,483	465	811,479	1,043	1,229,528	5,413	3,778,476	12,312	8,265,550
West North Central	7,892	5,875,467	2,602	2,307,605	218	325,627	758	879,969	1,626	1,102,009	5,290	3,567,862
South Atlantic	4,317	2,780,706	1,356	1,154,759	196	248,425	430	448,923	730	457,411	2,961	1,625,947
East South Central	2,426	1,641,770	730	658,536	78	127,097	259	289,014	393	242,425	1,696	983,234
West South Central	3,655	2,543,847	1,188	1,037,868	114	175,118	374	405,230	700	457,520	2,467	1,505,979
Mountain	3,090	2,927,122	1,228	1,368,792	105	217,105	273	410,261	850	741,426	1,862	1,558,330
Pacific	7,348	7,090,631	2,649	3,082,271	143	463,049	376	711,912	2,130	1,907,310	4,699	4,008,360
New England:												
Maine	629	402,394	179	172,777	39	47,794	60	78,975	80	46,008	450	229,617
New Hampshire	578	434,617	170	141,361	52	46,128	41	48,093	77	47,140	408	293,256
Vermont	340	219,897	128	92,242	34	29,458	38	37,372	56	25,412	212	127,655
Massachusetts	3,954	2,981,043	992	945,461	148	224,034	168	313,061	676	408,366	2,962	2,035,582
Rhode Island	511	512,771	146	191,582	14	38,840	28	58,773	109	93,969	365	321,189
Connecticut	1,340	1,054,261	337	330,304	48	85,372	59	95,459	230	149,473	1,003	723,957
Middle Atlantic:												
New York	13,733	11,034,898	4,726	4,469,644	248	563,178	443	812,508	4,035	3,093,958	9,007	6,565,254
New Jersey	2,989	2,479,219	640	656,493	58	140,597	97	148,271	485	367,625	2,349	1,822,726
Pennsylvania	7,300	5,098,265	2,101	1,878,126	221	295,835	350	515,400	1,530	1,066,891	5,199	3,220,139
East North Central:												
Ohio	3,131	2,264,892	967	740,974	107	147,517	170	198,477	690	394,980	2,164	1,523,918
Indiana	2,269	1,525,875	700	542,408	54	70,492	191	209,932	455	261,984	1,569	983,467
Illinois	8,036	6,223,882	3,539	3,101,656	117	292,240	263	354,387	3,159	2,455,029	4,497	3,122,226
Michigan	3,876	2,843,371	1,225	1,040,732	106	200,010	270	298,201	849	542,521	2,651	1,802,639
Wisconsin	1,921	1,227,013	490	393,713	81	101,220	149	168,531	260	123,962	1,431	833,300
West North Central:												
Minnesota	1,568	1,222,493	638	592,723	40	74,529	168	185,669	430	332,525	930	629,770
Iowa	1,329	921,096	481	377,129	54	49,050	155	176,731	272	151,348	848	543,967
Missouri	2,434	1,883,844	662	609,860	54	109,829	140	182,234	468	317,797	1,772	1,273,984
North Dakota	232	197,983	81	85,667	3	3,800	29	42,757	49	39,110	151	112,316
South Dakota	338	264,159	125	130,532	8	19,275	44	54,676	73	56,581	213	133,627
Nebraska	882	598,703	264	230,423	28	29,661	83	91,689	153	109,073	618	368,280
Kansas	1,109	787,189	351	281,271	31	39,483	139	146,213	181	95,575	758	505,918
South Atlantic:												
Delaware, Maryland, and District of Columbia	1,249	936,805	431	417,391	45	94,421	68	98,567	318	224,403	818	519,414
Virginia	341	170,884	102	62,383	21	11,750	39	33,001	42	17,632	239	108,501
West Virginia	439	255,471	110	82,720	23	17,554	34	38,896	53	26,270	329	172,751
North Carolina	453	261,078	167	108,049	29	20,911	71	64,177	67	22,961	286	153,029
South Carolina	683	452,456	174	179,250	44	66,453	59	65,748	71	47,049	509	273,206
Georgia	697	417,959	231	181,345	23	22,304	116	108,844	92	50,197	466	236,614
Florida	455	286,053	141	123,621	11	15,032	43	39,690	87	68,899	314	162,432
East South Central:												
Kentucky	907	635,829	246	254,065	35	66,246	74	95,227	137	92,592	661	381,764
Tennessee	656	455,212	191	169,011	23	39,140	76	82,091	92	47,780	465	286,201
Alabama	456	286,936	181	147,488	10	12,450	56	57,236	115	77,802	275	139,448
Mississippi	407	263,793	112	87,972	10	9,261	53	54,460	49	24,251	295	175,821
West South Central:												
Arkansas	360	242,267	110	89,048	9	7,539	54	59,160	47	22,349	250	153,219
Louisiana	489	371,034	175	158,233	8	20,708	30	40,013	137	97,512	314	212,801
Oklahoma	785	581,580	265	232,790	27	36,272	97	114,179	141	82,339	520	348,790
Texas	2,021	1,348,966	638	557,797	70	110,599	193	191,878	375	255,320	1,383	791,169
Mountain:												
Montana	514	625,918	165	235,172	10	33,420	39	64,102	116	137,650	349	390,746
Idaho	324	334,063	141	167,883	12	32,143	42	71,445	87	64,295	183	166,180
Wyoming	163	149,356	40	46,660	....	....	18	25,480	22	21,180	123	102,696
Colorado	1,166	999,864	415	446,686	42	90,090	83	121,123	290	235,473	751	553,178
New Mexico	158	119,088	54	50,916	5	3,412	21	26,209	28	21,295	104	68,172
Arizona	217	219,798	74	99,517	16	23,390	19	35,943	39	40,184	143	120,281
Utah	401	365,399	271	268,636	17	30,610	42	55,189	212	182,837	130	96,763
Nevada	147	113,636	68	53,322	3	4,040	9	10,770	56	38,512	79	60,314
Pacific:												
Washington	1,078	880,309	311	297,491	23	28,481	79	106,561	209	162,449	767	582,818
Oregon	532	387,119	181	145,231	16	24,349	51	64,064	114	56,818	351	241,888
California	5,738	5,823,203	2,157	2,639,549	104	410,219	246	541,287	1,807	1,688,043	3,581	3,183,654

Although not given in this table, the figures for geographic divisions in 1902, when compared with corresponding data for salaries and wages in 1912, show that the largest actual increase, $11,790,522, or 172.8 per cent, was for the Middle Atlantic division. During the decade 1902–1912 the largest percentage of increase (353.8) occurred in the Pacific division. The South Atlantic division was second in rate of growth in salaries and wages from 1902 to 1912, with 247.9 per cent, chiefly by reason of large gains in North Carolina, South Carolina, Florida, and Georgia.

Reference to the statistics for central stations in 1902 shows that the six ranking states in number of employees were New York, Pennsylvania, Illinois, Massachusetts, Ohio, and California, in the order named. In 1912 Ohio was seventh, and the six ranking states were New York, Illinois, Pennsylvania, California, Michigan, and Massachusetts.

TITLES OF GENERAL TABLES.

The general tables listed below present the fundamental data, as shown by the title, gathered at the 1912 census of central electric light and power stations. These data relate to commercial and municipal stations, considered separately and in combination, and embrace statistics of income, expenses, primary power, equipment of stations and line equipment, and number of customers. The first of the tables is a comparative summary, covering the whole field of the inquiry, and including the figures for 1907 and 1902, as well as those for 1912.

Table 55.—Commercial and municipal central electric stations—Comparative summary, by geographic divisions and states: 1912, 1907, and 1902 (p. 82).

Table 56.—Commercial and municipal central electric stations—Income, by geographic divisions and states: 1912 (p. 88).

Table 57.—Commercial central electric stations—Income, by geographic divisions and states: 1912 (p. 89).

Table 58.—Municipal central electric stations—Income, by geographic divisions and states: 1912 (p. 90).

Table 59.—Commercial and municipal central electric stations—Expenses, by geographic divisions and states: 1912 (p. 92).

Table 60.—Commercial central electric stations—Expenses, by geographic divisions and states: 1912 (p. 94).

Table 61.—Municipal central electric stations—Expenses, by geographic divisions and states: 1912 (p. 96).

Table 62.—Commercial and municipal central electric stations—Primary power, by geographic divisions and states: 1912 (p. 98).

Table 63.—Commercial central electric stations—Primary power, by geographic divisions and states: 1912 (p. 100).

Table 64.—Municipal central electric stations—Primary power, by geographic divisions and states: 1912 (p. 102).

Table 65.—Commercial and municipal central electric stations—Generating and subsidiary equipment, and output of stations, by geographic divisions and states: 1912 (p. 104).

Table 66.—Commercial central electric stations—Generating and subsidiary equipment, and output of stations, by geographic divisions and states: 1912 (p. 105).

Table 67.—Municipal central electric stations—Generating and subsidiary equipment, and output of stations, by geographic divisions and states: 1912 (p. 106).

Table 68.—Commercial and municipal central electric stations—Line equipment and number of customers, by geographic divisions and states: 1912 (p. 107).

Table 69.—Commercial central electric stations—Line equipment and number of customers, by geographic divisions and states: 1912 (p. 108).

Table 70.—Municipal central electric stations—Line equipment and number of customers, by geographic divisions and states: 1912 (p. 109).

Table 55.—COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—COMPARATIVE

	DIVISION AND STATE.	Census.	Number of stations.	INCOME.			Total expenses, including salaries and wages.	Total number of persons employed.	Number of customers furnished current.	Number of meters on consumption circuits.	PRIMARY POWER.		
				Total.	Electric service, including estimated value of free service.	All other sources.					Total horsepower.	Steam engines and steam turbines.[1]	
												Number.	Horsepower.
1	United States	1912	5,221	$302,115,599	$286,980,858	$15,134,741	$234,419,478	79,335	3,837,518	3,617,189	7,528,648	7,844	4,946,532
2		1907	4,714	175,642,338	169,614,691	6,027,647	134,196,911	47,632	1,946,979	1,683,917	4,098,188	8,054	2,693,273
3		1902	3,620	85,700,605	84,186,605	1,514,000	68,081,375	30,326	....	582,689	1,845,048	6,295	1,394,395
	Geographic divisions.												
4	New England	1912	368	29,634,769	28,457,210	1,177,559	21,414,431	7,352	313,227	312,278	735,244	560	519,426
5		1907	365	18,660,504	18,123,382	537,122	12,576,539	5,088	162,875	161,800	415,794	673	280,940
6		1902	314	10,697,077	10,504,638	192,439	7,953,633	3,673	....	87,986	247,044	635	184,207
7	Middle Atlantic	1912	669	92,551,203	87,258,721	5,292,482	71,821,417	24,022	822,906	842,450	2,013,317	1,419	1,340,485
8		1907	705	56,826,940	55,378,928	1,448,012	42,716,857	13,977	419,837	414,944	1,118,792	1,562	768,073
9		1902	599	29,763,010	29,410,254	352,756	25,668,247	9,675	....	152,147	567,684	1,412	426,687
10	East North Central	1912	1,260	67,454,476	63,390,456	4,064,020	53,414,485	19,233	972,903	940,883	1,690,999	2,025	1,404,897
11		1907	1,295	35,898,969	34,141,889	1,757,080	26,290,791	10,324	485,534	425,378	838,281	2,199	690,946
12		1902	1,112	17,195,031	16,865,344	329,687	12,727,726	6,866	....	151,977	385,446	1,818	346,000
13	West North Central	1912	1,077	28,948,207	27,543,539	1,404,668	22,939,987	7,892	505,019	451,386	601,750	1,328	465,027
14		1907	800	15,888,407	15,201,470	686,937	13,517,524	5,007	236,622	193,930	381,635	1,308	284,013
15		1902	594	7,454,768	7,287,241	167,527	5,953,048	3,067	....	63,828	154,223	865	139,625
16	South Atlantic	1912	512	16,491,595	15,980,397	511,198	12,126,351	4,317	193,909	167,314	621,114	663	274,488
17		1907	390	7,672,229	7,480,058	192,171	7,012,180	2,622	93,471	72,130	295,265	573	157,283
18		1902	251	3,564,173	3,494,151	70,022	2,792,572	1,537	....	17,384	92,641	399	71,889
19	East South Central	1912	330	7,627,840	7,473,022	154,818	5,857,329	2,426	132,433	107,106	215,731	523	177,021
20		1907	284	4,660,126	4,542,134	117,992	3,558,852	1,632	70,798	50,417	112,640	475	104,333
21		1902	180	2,514,765	2,475,638	39,127	1,858,522	1,017	....	14,736	55,698	290	54,979
22	West South Central	1912	507	12,474,439	12,209,711	264,728	9,165,847	3,655	223,283	192,764	233,563	780	208,206
23		1907	395	7,426,620	7,259,900	166,720	5,905,917	2,474	117,055	83,181	131,782	636	125,030
24		1902	224	3,752,958	3,697,480	55,478	2,616,226	1,350	....	23,331	61,494	358	60,055
25	Mountain	1912	250	14,737,073	13,849,566	887,507	11,400,235	3,090	182,108	152,738	426,783	268	108,769
26		1907	219	8,816,227	8,504,933	311,294	6,365,126	2,028	107,831	78,742	225,287	297	87,414
27		1902	152	4,217,173	4,127,455	89,718	3,441,299	1,320	....	28,506	105,338	237	43,457
28	Pacific	1912	248	32,195,997	30,818,236	1,377,761	26,279,396	7,348	491,730	450,270	990,147	278	448,213
29		1907	261	19,792,316	18,981,997	810,319	16,253,125	4,480	252,956	203,395	578,712	331	195,241
30		1902	194	6,541,650	6,324,404	217,246	5,070,102	1,821	....	42,794	175,480	281	67,496
	New England.												
31	Maine	1912	79	2,118,508	1,815,086	303,422	1,577,938	629	28,511	25,062	89,683	58	19,610
32		1907	81	1,453,016	1,324,648	128,368	1,181,255	502	19,614	16,230	57,880	83	18,114
33		1902	52	692,350	668,575	23,775	571,089	340	....	5,157	24,889	64	11,843
34	New Hampshire	1912	59	2,328,263	2,200,733	127,530	1,596,152	578	22,752	21,241	84,228	56	25,386
35		1907	56	1,422,345	1,321,296	101,049	912,214	422	14,082	11,764	46,784	57	20,265
36		1902	51	832,322	826,176	6,146	554,967	294	....	5,490	28,096	43	12,640
37	Vermont	1912	61	1,228,361	1,182,797	45,564	824,443	340	22,380	18,880	50,363	40	14,996
38		1907	60	841,701	795,391	46,310	682,003	297	15,361	12,698	38,566	41	9,889
39		1902	52	485,505	461,898	23,607	333,853	242	....	5,051	23,857	36	7,436
40	Massachusetts	1912	117	16,306,909	15,996,463	310,446	11,651,739	3,954	163,993	170,310	350,780	270	323,128
41		1907	120	10,749,240	10,602,498	146,742	7,065,197	2,672	80,713	87,824	188,335	323	170,457
42		1902	114	6,340,944	6,244,882	96,062	4,708,732	2,024	....	56,969	124,213	364	115,195
43	Rhode Island	1912	8	2,305,176	2,204,999	100,177	1,654,848	511	19,088	24,276	50,499	18	46,934
44		1907	7	1,724,659	1,627,190	97,469	1,053,639	450	11,591	13,212	27,986	46	24,723
45		1902	7	1,026,407	985,595	40,812	803,161	274	....	6,152	17,600	35	15,675
46	Connecticut	1912	44	5,347,552	5,057,132	290,420	4,109,311	1,340	56,503	52,509	109,691	118	89,372
47		1907	41	2,469,543	2,452,359	17,184	1,682,231	745	21,514	20,072	56,243	123	37,492
48		1902	38	1,319,549	1,317,512	2,037	981,831	499	....	9,167	28,389	93	21,418
	Middle Atlantic.												
49	New York	1912	321	57,218,973	53,189,000	4,029,973	44,297,869	13,733	434,110	461,591	1,157,809	553	638,932
50		1907	314	34,859,170	34,067,383	791,787	25,961,930	7,716	201,701	217,462	722,653	570	413,388
51		1902	256	16,854,839	16,742,239	112,600	14,706,366	5,421	....	73,789	323,413	523	192,623
52	New Jersey	1912	64	10,944,367	10,587,513	356,854	9,348,864	2,989	105,785	108,579	239,514	251	235,585
53		1907	64	5,952,378	5,910,745	41,633	4,599,586	1,759	57,179	55,296	93,602	224	90,480
54		1902	64	3,421,304	3,356,599	64,705	3,413,914	1,074	....	21,484	68,761	197	67,325
55	Pennsylvania	1912	284	24,387,863	23,482,208	905,655	18,174,684	7,300	283,011	272,280	615,994	615	465,968
56		1907	327	16,015,392	15,400,800	614,592	12,155,341	4,502	160,957	142,186	302,537	768	264,205
57		1902	279	9,486,867	9,311,416	175,451	7,547,967	3,180	....	56,874	175,510	692	166,739

[1] Includes auxiliary engines.

SUMMARY, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902.

PRIMARY POWER—continued.				KILOWATT CAPACITY OF DYNAMOS.			Total output of stations, kilowatt hours.	ESTIMATED NUMBER OF LAMPS WIRED FOR SERVICE.		STATIONARY MOTORS SERVED.		
Gas and oil engines.		Water wheels.		Total.	Direct current.	Alternating current.		Arc.	Incandescent and other varieties.	Number	Horse-power capacity.	
Number	Horse-power.	Number.	Horse-power.									
1,116	111,035	2,933	2,471,081	5,134,689	473,490	4,661,199	11,532,963,006	505,395	76,507,142	435,473	4,130,619	1
463	55,828	2,481	1,349,087	2,709,225	487,452	2,221,773	5,862,276,737	[2]555,713	[2]41,608,335	167,184	1,649,026	2
165	12,181	1,390	438,472	1,212,235	475,931	736,304	2,507,051,115	385,698	18,194,044	101,064	438,005	3
50	7,317	511	208,501	514,889	39,368	475,521	879,272,535	44,682	7,957,913	55,042	391,308	4
34	4,123	462	130,731	289,388	65,008	224,380	473,802,067	56,041	4,678,690	23,841	154,720	5
14	666	295	62,171	162,789	66,748	96,041	247,727,501	47,017	2,425,235	12,736	62,163	6
171	26,564	559	646,268	1,378,811	158,759	1,220,052	3,548,605,305	181,582	22,103,919	124,416	1,213,681	7
103	12,112	503	338,607	765,140	150,199	614,941	2,009,304,160	186,279	12,589,744	34,108	544,020	8
39	4,219	305	136,778	354,760	137,693	217,067	1,021,603,500	122,537	6,135,970	29,938	149,083	9
218	22,120	636	263,982	1,176,528	132,064	1,044,464	2,527,964,097	138,042	18,600,072	114,404	799,421	10
120	10,475	573	136,860	559,760	129,554	430,206	1,075,933,354	153,534	9,688,947	49,345	307,558	11
51	3,238	270	36,208	275,569	138,563	137,006	475,097,910	110,507	4,392,386	23,257	80,304	12
416	26,003	224	110,720	404,172	54,168	350,004	712,595,442	40,860	8,327,927	47,540	316,113	13
94	6,211	188	91,411	245,252	54,246	191,006	386,180,647	50,714	4,629,533	19,027	138,027	14
28	1,360	88	13,238	99,945	44,839	55,106	169,964,203	35,022	1,784,533	9,767	33,331	15
54	6,098	298	340,528	412,779	20,059	392,720	679,856,425	21,389	3,887,442	26,163	361,011	16
18	1,445	194	136,537	195,309	20,664	174,645	266,437,175	27,103	1,925,588	8,948	95,373	17
10	700	48	20,052	62,301	20,083	42,218	102,990,575	17,183	611,001	2,516	16,541	18
13	1,080	47	37,630	150,042	17,181	132,861	227,664,808	18,365	2,147,461	7,592	62,081	19
3	60	29	8,247	77,059	13,602	63,457	118,631,967	17,911	1,164,424	3,039	21,656	20
4	70	9	649	39,327	14,166	25,161	73,750,879	11,328	463,437	3,935	7,510	21
151	16,679	35	8,678	158,369	23,201	135,168	233,947,656	19,645	3,286,431	15,337	103,765	22
59	3,690	24	3,062	88,910	23,826	65,084	138,755,643	21,883	1,543,610	7,220	42,507	23
2	108	14	1,331	42,932	14,668	28,264	80,154,471	11,992	558,861	10,633	11,024	24
20	2,695	294	315,319	261,119	8,869	252,250	845,393,882	9,926	2,239,337	12,114	235,506	25
13	855	216	137,018	151,032	11,873	139,159	381,032,187	11,859	1,321,876	6,091	94,960	26
11	1,202	141	60,679	65,952	16,088	49,864	145,780,112	9,348	612,258	2,394	20,953	27
23	2,479	329	539,455	677,980	19,821	658,159	1,877,662,856	30,904	7,056,640	32,865	647,733	28
19	16,857	292	366,614	337,375	18,480	318,895	1,012,199,537	30,389	4,065,923	15,565	250,205	29
6	618	220	107,366	108,660	23,083	85,577	189,981,964	20,764	1,210,363	5,888	57,096	30
3	135	175	69,938	58,757	3,763	54,994	117,092,565	1,863	481,748	2,258	32,535	31
....	....	132	39,766	39,290	7,005	32,285	66,136,651	3,187	443,192	1,304	19,372	32
....	....	54	13,046	15,291	5,164	10,127	21,987,700	2,254	204,632	525	6,437	33
11	1,905	115	56,937	57,768	3,261	54,507	126,593,970	1,900	397,491	1,958	18,488	34
8	1,115	101	25,404	31,917	3,782	28,135	55,258,921	3,510	301,734	1,061	10,231	35
1	50	78	15,406	17,777	3,614	14,163	27,377,793	2,879	170,541	415	4,583	36
2	95	99	35,272	29,468	183	29,285	56,552,977	1,080	404,151	1,966	23,695	37
4	205	101	28,472	21,854	1,401	20,453	29,923,333	1,866	306,245	776	9,778	38
1	125	80	16,296	11,442	2,205	9,237	22,374,060	1,534	161,106	273	2,787	39
22	3,172	58	24,480	252,732	21,357	231,375	386,254,294	28,238	4,687,246	37,191	228,868	40
12	1,097	58	16,781	135,924	33,892	102,032	219,425,607	33,869	2,655,303	15,877	81,246	41
3	85	41	8,933	90,624	42,585	48,039	125,813,392	28,790	1,420,963	9,663	35,749	42
5	1,125	13	2,440	38,509	3,659	34,850	62,106,528	4,419	640,769	3,690	28,186	43
4	1,000	16	2,263	21,040	10,181	10,859	35,651,323	5,970	385,329	2,082	12,947	44
....	....	11	1,925	12,139	7,060	5,079	23,436,435	5,161	196,188	989	6,236	45
7	885	51	19,434	77,655	7,145	70,510	130,672,201	7,182	1,346,508	7,979	59,536	46
6	706	54	18,045	39,363	8,747	30,616	67,406,232	7,639	586,887	2,741	21,146	47
9	406	31	6,565	15,516	6,120	9,396	26,738,121	6,399	271,805	871	6,371	48
66	6,471	405	512,406	772,030	69,024	703,006	2,175,048,634	94,324	12,884,911	82,525	795,256	49
26	3,315	362	305,950	482,031	59,914	422,117	1,452,222,471	97,529	7,017,061	18,051	393,955	50
13	2,005	241	128,785	187,252	60,494	126,758	701,769,716	59,130	3,705,525	13,581	109,277	51
21	2,360	18	1,569	179,477	35,428	144,049	383,891,504	22,585	2,961,343	12,772	85,011	52
11	1,328	22	1,794	70,566	24,984	45,582	140,527,522	21,973	1,675,021	5,994	27,604	53
6	431	14	1,005	46,120	20,855	25,265	78,739,456	15,685	646,762	2,213	9,246	54
84	17,733	136	132,293	427,304	54,307	372,997	989,665,167	64,673	6,257,665	29,119	333,414	55
66	7,469	119	30,863	212,543	65,301	147,242	416,554,167	66,777	3,897,662	10,063	122,461	56
20	1,783	50	6,988	121,388	56,344	65,044	241,094,328	47,722	1,783,683	14,144	30,560	57

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[2] Exclusive of 7,082 arc and 267,997 incandescent lamps reported by the electric companies to light their own properties.

Table 55.—COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—COMPARATIVE

	DIVISION AND STATE.	Census.	Number of stations.	INCOME.			Total expenses, including salaries and wages.	Total number of persons employed.	Number of customers furnished current.	Number of meters on consumption circuits.	PRIMARY POWER.		
				Total.	Electric service, including estimated value of free service.	All other sources.					Total horsepower.	Steam engines and steam turbines.[1] Number.	Steam engines and steam turbines.[1] Horsepower.
	East North Central.												
1	Ohio	1912	304	$11,905,111	$11,514,628	$390,483	$8,722,293	3,131	174,467	170,756	337,272	506	317,160
2		1907	272	7,643,997	7,474,980	169,017	6,027,780	2,157	100,071	92,964	179,111	515	171,446
3		1902	233	4,431,038	4,347,506	83,532	3,286,336	1,766	....	31,508	103,745	485	101,314
4	Indiana	1912	291	7,711,223	7,417,484	293,739	6,028,909	2,269	156,603	146,185	185,503	352	159,888
5		1907	200	4,438,332	4,222,610	215,722	3,627,336	1,618	86,237	72,483	116,828	381	95,927
6		1902	180	2,105,146	2,038,121	67,025	1,573,908	941	....	18,758	54,237	284	52,035
7	Illinois	1912	269	30,045,297	27,376,119	2,669,178	23,557,887	8,036	364,046	356,074	645,631	576	605,227
8		1907	383	15,465,993	14,566,772	899,221	10,055,463	3,902	167,645	146,208	299,246	733	287,898
9		1902	346	6,757,015	6,692,248	64,767	4,961,915	2,339	....	59,836	126,866	575	117,069
10	Michigan	1912	235	11,518,256	11,127,031	391,225	9,784,138	3,876	187,545	181,872	377,182	319	250,477
11		1907	234	6,072,010	5,750,447	321,563	4,611,070	1,780	87,500	78,950	184,207	323	97,866
12		1902	201	2,613,812	2,516,800	97,012	1,948,546	1,255	....	29,272	64,883	283	48,614
13	Wisconsin	1912	251	6,274,589	5,955,194	319,395	5,321,258	1,921	90,242	85,996	145,411	272	72,145
14		1907	206	2,278,637	2,127,080	151,557	1,969,142	867	44,081	34,773	58,889	247	37,809
15		1902	152	1,288,020	1,270,669	17,351	957,021	565	....	12,603	35,715	191	26,968
	West North Central.												
16	Minnesota	1912	195	6,937,841	6,647,199	290,642	5,580,525	1,568	104,504	98,660	148,111	247	63,184
17		1907	171	3,478,009	3,333,469	144,540	2,986,277	1,062	54,214	46,701	121,825	250	48,741
18		1902	138	1,858,789	1,838,806	19,983	1,459,874	649	....	16,528	34,823	207	28,118
19	Iowa	1912	223	4,405,365	4,078,167	327,198	3,328,740	1,329	90,299	83,294	77,131	308	67,444
20		1907	192	2,479,969	2,317,880	162,089	1,983,613	855	48,516	39,492	46,739	284	42,342
21		1902	169	1,545,663	1,477,348	68,315	1,223,682	732	....	17,034	39,504	243	36,705
22	Missouri	1912	190	9,746,600	9,299,495	447,105	7,484,853	2,434	143,997	120,689	182,095	301	177,721
23		1907	162	5,805,828	5,683,795	122,033	5,341,126	1,800	61,575	50,670	111,416	362	108,451
24		1902	123	2,392,149	2,360,150	31,999	2,042,422	997	....	16,096	45,318	207	44,307
25	North Dakota	1912	42	873,111	835,504	37,607	714,294	232	15,618	14,489	16,169	74	15,851
26		1907	29	533,383	480,042	53,341	413,506	150	7,999	6,493	10,277	58	9,972
27		1902	21	197,689	197,375	314	157,275	75	....	1,484	3,930	30	3,830
28	South Dakota	1912	77	1,162,522	1,095,922	66,600	965,763	338	20,391	18,644	27,748	50	16,003
29		1907	37	513,682	492,767	20,915	433,841	169	7,940	6,500	12,984	52	10,251
30		1902	28	207,868	204,292	3,576	157,971	85	....	1,851	5,057	30	4,010
31	Nebraska	1912	174	2,802,614	2,678,240	124,374	2,239,542	882	61,814	57,995	52,168	156	42,452
32		1907	98	1,562,669	1,474,426	88,243	1,158,060	404	27,086	22,710	30,020	135	26,221
33		1902	54	601,777	597,304	4,473	431,342	237	....	5,746	12,308	64	10,406
34	Kansas	1912	176	3,020,154	2,909,012	111,142	2,626,270	1,109	68,396	57,615	98,328	192	82,372
35		1907	111	1,514,867	1,419,091	95,776	1,201,101	567	29,292	21,364	48,374	167	38,035
36		1902	61	650,833	611,966	38,867	480,482	292	....	5,089	13,283	84	12,249
	South Atlantic.												
37	Delaware, District of Columbia, and Maryland	1912	56	5,230,604	5,146,534	84,070	4,056,055	1,249	66,465	62,230	113,078	106	107,956
38		1907	50	3,347,728	3,298,747	48,981	3,819,147	1,024	33,333	32,614	85,346	148	83,584
39		1902	42	1,712,048	1,693,396	18,652	1,446,850	549	....	8,602	29,863	117	29,508
40	Virginia	1912	67	805,022	794,858	10,164	567,459	341	14,948	10,642	59,585	66	15,120
41		1907	51	390,628	380,779	9,849	261,795	178	6,969	2,835	14,619	40	5,008
42		1902	37	210,632	210,176	456	171,185	170	....	772	5,443	47	4,222
43	West Virginia	1912	58	1,167,583	1,148,089	19,494	897,843	439	18,165	14,833	43,185	88	34,064
44		1907	48	724,253	689,919	34,334	534,365	262	9,404	5,936	21,428	75	16,876
45		1902	41	322,015	320,443	1,572	229,558	178	....	1,819	10,820	59	10,100
46	North Carolina	1912	94	1,458,786	1,404,167	54,619	1,046,217	453	25,676	20,800	64,983	89	14,952
47		1907	71	543,322	527,672	15,650	437,215	248	9,719	6,068	20,683	81	10,721
48		1902	38	250,133	241,903	8,230	192,775	141	....	1,346	6,566	44	4,646
49	South Carolina	1912	61	4,499,800	4,265,983	233,817	2,850,661	683	17,602	16,765	218,496	68	39,486
50		1907	40	901,537	865,708	35,829	634,375	261	8,054	6,632	84,115	51	8,535
51		1902	24	387,010	356,066	30,944	272,729	160	....	1,032	21,205	37	10,790
52	Georgia	1912	126	1,968,599	1,881,985	86,614	1,655,420	697	29,109	21,109	87,951	156	35,274
53		1907	93	1,110,510	1,086,601	23,909	844,557	384	15,452	10,075	54,704	104	18,229
54		1902	43	357,565	348,753	8,812	254,838	203	....	1,424	12,630	47	6,509
55	Florida	1912	50	1,361,201	1,338,781	22,420	1,052,696	455	21,944	20,935	33,836	90	27,636
56		1907	37	654,251	630,632	23,619	480,726	265	10,540	7,970	14,370	74	14,330
57		1902	26	324,770	323,414	1,356	224,637	136	....	2,389	6,114	48	6,114

[1] Includes auxiliary engines.

SUMMARY, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902—Continued.

PRIMARY POWER—continued.				KILOWATT CAPACITY OF DYNAMOS.			Total output of stations, kilowatt hours.	ESTIMATED NUMBER OF LAMPS WIRED FOR SERVICE.		STATIONARY MOTORS SERVED.		
Gas and oil engines.		Water wheels.		Total.	Direct current.	Alternating current.		Arc.	Incandescent and other varieties.	Number.	Horse-power capacity.	
Number	Horse-power.	Number.	Horse-power.									
93	11,252	33	8,860	244,182	49,450	194,732	399,101,309	36,318	3,454,515	29,022	145,331	1
53	5,628	21	2,037	126,533	40,121	86,412	217,311,924	43,849	2,267,958	13,083	64,941	2
13	755	14	1,676	69,811	41,448	28,363	127,437,383	31,839	934,213	5,704	21,956	3
17	1,700	90	23,915	135,801	14,605	121,196	236,944,000	17,328	2,375,680	14,005	91,897	4
15	1,295	83	19,606	81,576	19,290	62,286	130,263,693	22,165	1,330,660	5,132	33,716	5
16	1,097	12	1,105	38,144	16,961	21,183	75,585,493	15,325	656,451	2,631	5,653	6
35	3,042	92	37,362	449,917	33,707	416,210	1,150,900,306	53,486	7,375,539	46,278	315,659	7
19	870	80	10,478	209,226	44,250	164,976	467,657,328	55,309	3,591,309	21,675	137,661	8
7	292	52	9,505	100,320	51,216	49,104	161,543,646	38,215	1,567,665	11,838	35,928	9
27	1,626	245	125,079	247,789	13,565	234,224	525,615,508	20,516	3,602,606	18,400	174,009	10
11	603	249	85,738	101,714	15,089	86,625	208,154,199	23,514	1,717,339	7,089	53,245	11
3	184	114	16,085	44,176	18,043	26,133	80,564,630	17,712	805,127	2,271	11,337	12
46	4,500	176	68,766	98,839	20,737	78,102	215,402,974	10,394	1,791,732	6,699	72,525	13
22	2,079	140	19,001	40,711	10,804	29,907	52,546,210	8,697	781,681	2,366	17,995	14
12	910	78	7,837	23,118	10,895	12,223	29,966,758	7,416	428,930	813	5,430	15
54	4,755	76	80,172	93,502	13,854	79,643	186,045,055	9,201	1,858,306	12,203	75,973	16
22	1,428	71	71,656	78,516	14,354	64,162	87,579,431	13,398	903,023	3,711	41,095	17
13	665	27	6,040	20,999	9,333	11,666	40,258,632	8,543	384,705	1,855	9,481	18
52	2,658	58	7,029	53,237	13,611	39,626	67,166,647	4,679	1,512,568	8,773	43,820	19
11	564	44	3,833	32,056	12,297	19,759	37,729,072	7,352	809,386	2,643	14,547	20
5	400	31	2,399	24,886	12,786	12,100	36,506,425	5,929	420,847	1,054	4,193	21
22	2,472	5	1,902	122,786	10,859	111,927	232,828,763	13,394	2,526,515	15,429	116,971	22
13	963	5	2,002	68,467	10,938	57,529	147,328,446	17,576	1,705,396	8,923	54,111	23
2	11	2	1,000	32,100	13,889	18,211	57,450,731	13,144	593,798	4,646	14,552	24
8	318	....	....	10,824	4,607	6,217	12,298,553	866	219,452	1,145	6,128	25
2	205	1	100	5,819	3,789	2,030	8,229,765	1,163	119,233	327	1,816	26
....	....	1	100	2,042	1,470	572	5,850,115	502	41,916	81	703	27
86	4,832	15	6,913	20,032	2,492	17,540	24,703,754	1,134	278,221	1,394	13,619	28
10	528	12	2,205	10,046	1,488	8,558	13,615,015	1,278	129,643	279	3,649	29
5	202	7	845	2,910	1,032	1,878	4,256,007	798	63,248	43	239	30
91	3,832	44	5,884	34,586	4,310	30,276	56,299,682	3,682	1,034,661	3,575	26,325	31
17	845	19	2,954	20,041	4,080	15,961	31,958,739	4,262	490,101	1,719	10,776	32
3	82	9	1,820	8,412	2,420	5,992	12,315,775	2,608	151,162	604	2,278	33
103	7,136	26	8,820	69,205	4,435	64,770	133,252,988	7,904	898,204	5,021	33,277	34
19	1,678	36	8,661	30,307	7,300	23,007	59,740,179	5,685	472,751	1,425	12,033	35
....	....	11	1,034	8,596	3,909	4,687	13,326,518	3,498	128,857	1,484	1,885	36
11	1,073	33	4,049	87,137	7,660	79,477	67,994,885	8,144	1,727,106	13,718	76,527	37
5	130	18	1,632	62,956	10,900	52,056	78,412,197	13,765	1,055,779	6,523	32,856	38
3	80	6	275	21,639	12,321	9,318	39,999,997	8,905	282,758	1,429	5,919	39
3	185	63	44,280	40,512	1,956	38,556	28,724,684	2,589	237,079	753	8,570	40
1	60	44	9,551	9,195	1,486	7,709	10,208,360	1,415	93,635	268	3,690	41
....	....	10	1,221	3,827	1,077	2,750	6,879,243	1,278	37,645	450	257	42
24	3,085	14	6,036	29,772	4,510	25,262	42,344,796	2,468	305,312	1,279	22,925	43
9	925	11	3,627	14,726	2,764	11,962	24,871,317	2,885	160,279	340	4,432	44
7	620	1	100	6,985	2,285	4,700	11,355,905	1,898	78,066	136	291	45
3	80	52	49,951	43,099	814	42,285	70,552,737	1,928	571,384	1,876	32,830	46
....	....	32	9,962	13,911	2,147	11,764	13,171,681	1,936	144,256	249	4,345	47
....	....	10	1,920	4,141	1,182	2,959	8,351,346	1,178	45,181	161	950	48
3	455	88	178,555	32,408	2,615	129,793	356,771,757	2,345	268,721	5,452	155,385	49
1	150	52	75,430	51,271	191	51,080	68,696,424	2,521	150,018	969	37,388	50
....	....	9	10,415	13,390	680	12,710	18,426,763	1,366	46,068	160	6,546	51
4	720	45	51,957	56,232	1,581	54,651	87,571,815	2,651	410,068	1,964	50,633	52
1	140	37	36,335	35,446	1,702	33,744	59,311,202	3,173	180,337	410	11,078	53
....	....	12	6,121	7,620	1,471	6,149	9,911,243	1,452	60,139	47	2,123	54
6	500	3	5,700	23,619	923	22,696	25,895,751	1,264	367,772	1,121	14,141	55
1	40	....	....	7,804	1,474	6,330	11,765,994	1,408	141,284	189	1,584	56
....	....	....	....	4,699	1,067	3,632	8,066,078	1,106	61,144	133	455	57

Table 55.—COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—COMPARATIVE

	DIVISION AND STATE.	Census.	Number of stations.	INCOME.			Total expenses, including salaries and wages.	Total number of persons employed.	Number of customers furnished current.	Number of meters on consumption circuits.	PRIMARY POWER.		
				Total.	Electric service, including estimated value of free service.	All other sources.					Total horse-power.	Steam engines and steam turbines.[1]	
												Number.	Horse-power.
	East South Central.												
1	Kentucky	1912	89	$2,754,115	$2,683,137	$70.978	$2,244,906	907	51,204	41,200	81,767	171	81,191
2		1907	83	1,660,700	1,610,475	50,225	1,283.918	585	24,282	18,350	41,984	157	41,969
3		1902	58	850,086	848,399	1,687	709,234	367	....	5,209	21,415	100	21,340
4	Tennessee	1912	90	2.448,218	2.408,762	39,456	1,753,875	656	35,326	29,678	68,994	130	40,799
5		1907	78	1,299,983	1,266,610	33,373	882,763	416	16,426	11,397	28,730	128	27,490
6		1902	54	912,482	911,555	927	587,032	306	....	6,118	19,003	93	18,384
7	Alabama	1912	69	1,257,720	1,234,540	23,180	980,169	456	23,890	17,870	34,473	94	24,574
8		1907	55	1,012,743	997,506	15,237	872,302	343	16,261	11,436	26,404	84	19,377
9		1902	25	385,263	374,138	11,125	284,537	162	....	1,460	7,620	37	7,595
10	Mississippi	1912	82	1,167,787	1,146,583	21,204	878,379	407	22,013	18,358	30,497	128	30,457
11		1907	68	686.700	667,543	19,157	519.869	288	13,829	9,234	15,522	106	15,497
12		1902	43	366,934	341,546	25,388	277,719	182	....	1,949	7,660	60	7,660
	West South Central.												
13	Arkansas	1912	74	1,053,763	1,016,664	37,099	749,029	360	20,500	15,035	25,860	115	22,599
14		1907	63	675,718	664,916	10,802	491,871	244	12,071	6,503	13,953	98	13,641
15		1902	42	425,317	413,775	11,542	278,817	149	....	2,791	8,433	63	8,206
16	Louisiana	1912	50	2,278,754	2,251,102	27,652	1,604,019	489	27,838	26,538	27,165	86	26,175
17		1907	42	1,852,383	1,829.128	23,255	1,291.908	541	15,972	15,116	23,292	86	22,872
18		1902	25	971,631	967,027	4,604	682,939	336	....	5,551	13,767	49	13,767
19	Oklahoma	1912	130	2,357,950	2,287,329	70,621	1,888,706	785	46,860	37,860	53,922	194	45,821
20		1907	72	1,106,316	1,097,134	9,182	1,025,702	414	20,565	13,937	22,623	113	22,423
21		1902	20	281,452	267,453	13,999	176,539	92	....	1,211	4,407	28	4,407
22	Texas	1912	253	6,783,972	6,654,616	129,356	4,924,093	2,021	128,085	113,331	126,616	385	113,611
23		1907	218	3,792,203	3,668,722	123,481	3,096,436	1,275	68,447	47,625	71,914	339	66,094
24		1902	137	2,074,558	2,049,225	25,333	1,477,931	773	....	13,778	34,887	218	33,675
	Mountain.												
25	Montana	1912	29	3,883,410	3,292,385	591,025	2,411,668	514	32,312	30,543	115,710	38	12,750
26		1907	33	2,469,131	2,376,472	92,659	1,469,808	319	17,630	15,105	68,817	31	11,830
27		1902	27	1,025,971	1,017,805	8,166	660,476	202	....	4,923	31,887	30	7,885
28	Idaho	1912	38	1,615,940	1,580,082	35,858	1,537,260	324	26,078	17,694	56,375	14	4,525
29		1907	42	719,395	692,489	26,906	475,818	188	12,656	7,160	13,694	19	2,202
30		1902	19	192,206	191,126	1,080	141,160	88	....	547	5,454	14	1,480
31	Wyoming	1912	20	607,095	595,465	11,630	445,789	163	8,437	6,729	11,596	45	10,162
32		1907	18	317,580	303,683	13,897	235,846	96	5,116	3,199	5,125	34	4,360
33		1902	13	159,216	159,016	200	111,582	53	....	997	3,229	25	2,654
34	Colorado	1912	73	4,791,340	4,626,693	164,647	3,997,760	1,166	68,046	66,359	134,004	94	56,919
35		1907	56	3,410,240	3,317,844	92,396	2,785,401	918	46,911	41,050	82,427	141	56,547
36		1902	48	1,652,505	1,628,953	23,552	1,537,471	588	....	14,275	38,268	114	25,518
37	New Mexico	1912	21	497,895	488,422	9,473	449,516	158	8,551	7,129	11,015	32	8,428
38		1907	15	292,682	289,962	2,720	226,937	83	4,494	2,701	4,548	26	4,035
39		1902	11	135,307	133,747	1,560	102,201	45	....	322	1,780	21	1,730
40	Arizona	1912	16	1,173,186	1,128,862	44,324	923,258	217	12,668	10,256	22,075	33	12,775
41		1907	15	569,850	544,192	25,658	464,350	148	5,854	5,025	7,746	32	6,926
42		1902	13	293,066	288,019	5,047	240,953	86	....	1,360	2,540	20	1,890
43	Utah	1912	45	1,549,265	1,530,060	19,205	1,206,729	401	19,887	9,329	60,588	6	1,000
44		1907	31	665,241	627,332	37,909	461,675	198	11,212	2,197	35,950	10	1,279
45		1902	16	714,353	664,240	50,113	607,769	240	....	6,014	20,460	9	2,050
46	Nevada	1912	8	618,942	607,597	11,345	428,255	147	6,129	4,699	15,420	6	2,210
47		1907	9	372,108	352,959	19,149	245,291	78	3,958	2,305	6,980	4	235
48		1902	5	44,549	44,549	....	39,687	18	....	68	1,720	4	250
	Pacific.												
49	Washington	1912	70	3,087,721	2,976,297	111,424	2,270,132	1,078	73,421	66,106	95,884	55	18,128
50		1907	71	3,410,542	3,219,814	190,728	2,388,628	885	46,452	38,699	67,224	64	11,016
51		1902	40	783,651	739,743	43,908	651,495	274	....	5,675	22,894	48	5,656
52	Oregon	1912	66	1,422,703	1,380,785	41,918	1,205,738	532	33,627	24,290	46,015	54	15,879
53		1907	61	1,965,245	1,840,155	125,090	1,283,560	467	33,475	21,312	126,815	66	24,581
54		1902	39	691,582	638,571	53,011	499,632	187	....	2,895	17,798	39	6,603
55	California	1912	112	27,685,573	26,461,154	1,224,419	22,803,526	5,738	384,682	359,874	848,248	169	414,206
56		1907	129	14,416,529	13,922,028	494,501	12,580,937	3,128	173,029	143,384	384,673	201	159,644
57		1902	115	5,066,417	4,946,090	120,327	3,918,975	1,360	....	34,224	134,788	194	55,237

[1] Includes auxiliary engines.

SUMMARY, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902—Continued.

PRIMARY POWER—continued.				KILOWATT CAPACITY OF DYNAMOS.			Total output of stations, kilowatt hours.	ESTIMATED NUMBER OF LAMPS WIRED FOR SERVICE.		STATIONARY MOTORS SERVED.		
Gas and oil engines.		Water wheels.		Total.	Direct current.	Alternating current.		Arc.	Incandescent and other varieties.	Number.	Horse-power capacity.	
Number	Horse-power.	Number.	Horse-power.									
6	576	...	...	54,062	7,144	46,918	75,593,179	7,814	849,220	4,106	22,621	1
1	15	...	...	29,140	5,944	23,196	37,232,623	6,884	483,796	1,124	9,962	2
3	45	1	30	15,012	6,626	8,386	27,835,614	4,598	142,662	785	3,172	3
4	445	32	27,750	49,640	3,113	46,527	75,544,893	4,808	671,150	1,720	20,357	4
...	...	14	1,240	20,911	2,265	18,646	34,847,956	4,407	306,903	1,193	4,524	5
...	...	8	619	14,736	4,772	9,964	24,472,632	3,662	174,291	1,218	3,335	6
2	19	15	9,880	24,477	4,442	20,035	48,602,553	3,920	347,871	1,065	11,148	7
1	20	15	7,007	17,124	4,342	12,782	30,846,764	4,926	232,646	541	5,650	8
1	25	...	...	4,473	1,769	2,704	11,616,707	2,033	61,373	750	747	9
1	40	...	...	21,863	2,482	19,381	27,924,183	1,823	279,220	701	7,955	10
1	25	...	...	9,884	1,051	8,833	15,704,624	1,694	141,079	181	1,520	11
...	...	...	...	5,106	999	4,107	9,825,926	1,035	85,111	1,182	256	12
5	221	10	3,040	16,335	2,053	14,282	17,786,660	1,102	243,728	994	5,283	13
1	12	1	300	9,678	2,599	7,079	11,519,316	1,669	142,525	198	1,177	14
...	...	2	227	6,024	1,485	4,539	9,965,997	1,654	82,234	838	722	15
9	990	...	...	19,169	5,697	13,472	18,328,080	7,267	584,015	2,428	24,557	16
3	420	...	...	15,175	5,762	9,413	26,421,316	8,587	377,225	1,713	16,110	17
...	...	...	...	7,781	4,690	3,091	17,474,261	4,278	135,593	1,129	5,128	18
38	5,966	7	2,135	38,301	4,130	34,171	48,824,097	3,659	592,315	3,470	23,056	19
2	200	...	...	15,499	3,120	12,379	24,985,903	3,451	219,537	1,086	6,586	20
...	...	...	...	3,019	740	2,279	3,825,763	914	37,443	430	347	21
99	9,502	18	3,503	84,564	11,321	73,243	149,008,819	7,617	1,866,373	8,445	50,869	22
53	3,058	23	2,762	48,558	12,345	36,213	75,829,108	8,176	804,323	4,223	18,634	23
2	108	12	1,104	26,108	7,753	18,355	48,888,450	5,146	303,591	8,236	4,827	24
1	75	64	102,885	74,398	1,635	72,763	379,212,617	2,193	388,718	1,962	75,184	25
...	...	62	56,987	39,602	2,410	37,192	137,379,261	3,132	231,201	971	33,240	26
1	2	44	24,000	22,055	3,521	18,534	36,435,766	1,648	101,868	151	1,401	27
...	...	63	51,850	35,656	126	35,530	115,812,292	1,349	261,096	1,723	27,142	28
...	...	37	11,492	7,082	147	6,935	9,577,588	966	122,491	406	4,054	29
1	50	23	3,924	2,774	797	1,977	5,018,149	557	33,262	163	205	30
1	100	11	1,334	8,212	1,077	7,135	11,580,567	492	112,228	672	6,224	31
...	...	6	765	3,208	1,003	2,205	5,499,084	517	59,674	131	685	32
2	500	1	75	1,831	701	1,130	3,883,285	259	22,082	1	1	33
1	80	67	77,005	71,668	3,391	68,277	165,196,068	4,175	1,032,865	4,780	60,451	34
4	300	47	25,580	53,130	6,029	47,101	123,275,212	5,391	649,494	3,232	41,161	35
...	...	42	12,750	21,808	7,131	14,677	60,177,084	4,770	295,605	1,264	12,484	36
9	1,770	9	817	7,981	876	7,105	9,027,824	377	112,207	639	4,084	37
...	...	6	513	3,789	925	2,864	4,614,349	332	55,379	195	1,231	38
...	...	1	50	986	657	329	2,637,810	272	22,507	75	100	39
...	...	4	9,300	14,756	991	13,765	32,960,084	686	136,400	741	12,547	40
3	70	4	750	4,939	777	4,162	9,392,302	754	72,028	339	2,220	41
7	650	...	...	1,811	908	903	3,662,045	295	36,556	432	714	42
...	...	63	59,588	37,935	435	37,500	86,634,658	333	150,380	1,044	37,490	43
...	...	45	34,671	33,592	522	33,070	61,672,661	440	67,670	406	5,519	44
...	...	26	18,410	13,923	2,208	11,715	32,457,063	1,469	92,165	295	5,868	45
8	670	13	12,540	10,513	338	10,175	44,969,772	321	45,443	553	12,384	46
6	485	9	6,260	5,690	60	5,630	29,621,730	327	63,939	411	6,850	47
...	...	4	1,470	764	165	599	1,508,910	78	8,213	13	180	48
3	165	64	77,591	57,283	1,658	55,625	71,414,473	4,729	781,244	2,279	28,148	49
2	90	48	56,118	66,308	5,484	60,824	257,785,236	6,771	624,865	1,933	29,686	50
...	...	41	17,238	13,679	5,019	8,660	19,722,262	2,977	108,443	295	2,780	51
9	334	60	29,802	32,416	624	31,792	58,789,342	1,285	382,196	1,527	15,843	52
6	182	72	102,052	32,587	3,877	28,710	92,807,992	3,927	372,844	2,072	20,452	53
...	...	46	11,195	11,165	1,780	9,385	17,531,660	2,023	95,045	403	4,020	54
11	1,980	205	432,062	588,281	17,539	570,742	1,747,459,041	24,890	6,793,200	29,059	603,742	55
11	16,585	172	208,444	238,480	9,119	229,361	661,606,309	19,691	3,068,214	11,560	200,067	56
6	618	133	78,933	83,816	16,284	67,532	152,728,042	15,764	1,006,875	5,190	50,296	57

Table 56.—COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—INCOME, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

DIVISION AND STATE.	Number of stations.	INCOME.									
		Gross income.	Electric service.							Interest and dividends from investments.	All other income.
			Total.	Commercial light, power, and heat.	Municipal street lighting.	Municipal building lighting.	Current sold to other public service corporations.	Estimated value of free service.			
								Commercial stations.	Municipal stations.		
UNITED STATES	5,221	$302,115,599	$286,980,858	$221,200,466	$27,273,226	$2,504,511	$31,019,660	$513,644	$4,469,351	$4,891,449	$10,243,292
GEOGRAPHIC DIVISIONS:											
New England	368	29,634,769	28,457,210	21,828,121	3,911,874	378,686	2,011,201	65,989	261,339	234,854	942,705
Middle Atlantic	669	92,551,203	87,258,721	66,477,359	9,656,407	1,287,893	9,223,081	231,846	382,135	2,529,416	2,763,066
East North Central	1,260	67,454,476	63,390,456	47,560,417	5,309,275	262,053	8,351,410	60,464	1,846,837	579,029	3,484,991
West North Central	1,077	28,948,207	27,543,539	22,110,443	2,294,839	124,273	2,461,151	37,781	517,052	247,684	1,156,984
South Atlantic	512	16,491,595	15,980,397	12,024,424	1,292,029	167,072	1,943,657	22,774	528,441	218,432	292,766
East South Central	330	7,627,840	7,473,022	5,592,315	921,573	39,500	425,941	16,674	477,019	8,872	145,946
West South Central	507	12,474,439	12,209,711	10,246,400	1,005,672	68,411	543,552	26,920	318,756	55,438	209,290
Mountain	250	14,737,073	13,849,566	11,799,538	725,953	39,783	1,192,588	31,486	60,218	387,638	499,869
Pacific	248	32,195,997	30,818,236	23,561,449	2,155,604	136,840	4,867,079	19,710	77,554	630,086	747,675
NEW ENGLAND:											
Maine	79	2,118,508	1,815,086	1,285,393	168,004	5,552	281,909	9,931	64,297	72,967	230,455
New Hampshire	59	2,328,263	2,200,733	1,257,060	272,209	14,023	656,176	1,265	....	75,614	51,916
Vermont	61	1,228,361	1,182,797	964,097	121,851	6,591	35,748	51,289	3,221	507	45,057
Massachusetts	117	16,306,909	15,996,463	12,629,531	2,322,146	307,194	542,179	1,592	193,821	17,957	292,489
Rhode Island	8	2,305,176	2,204,999	1,615,465	443,690	9,527	136,317	....	....	12,604	87,573
Connecticut	44	5,347,552	5,057,132	4,076,575	583,974	35,799	358,872	1,912	....	55,205	235,215
MIDDLE ATLANTIC:											
New York	321	57,218,973	53,189,000	42,388,607	4,556,339	1,006,637	5,090,032	41,008	106,377	2,204,211	1,825,762
New Jersey	64	10,944,367	10,587,513	7,277,259	1,736,989	198,590	1,331,792	27,102	15,781	31,234	325,620
Pennsylvania	284	24,387,863	23,482,208	16,811,493	3,363,079	82,666	2,801,257	163,736	259,977	293,971	611,684
EAST NORTH CENTRAL:											
Ohio	304	11,905,111	11,514,628	9,196,976	1,500,781	33,996	314,348	14,985	453,542	245,043	145,440
Indiana	201	7,711,223	7,417,484	5,877,523	885,881	21,637	393,011	9,992	229,440	29,176	264,563
Illinois	269	30,045,297	27,376,119	19,693,842	1,359,315	62,783	5,231,534	20,295	1,008,350	146,811	2,522,367
Michigan	235	11,518,256	11,127,031	8,323,535	870,479	113,192	1,679,498	5,919	134,408	22,797	368,428
Wisconsin	251	6,274,589	5,955,194	4,468,541	692,819	30,445	733,019	9,273	21,097	135,202	184,193
WEST NORTH CENTRAL:											
Minnesota	195	6,937,841	6,647,199	4,956,955	566,141	43,538	988,096	7,357	85,112	165,301	125,341
Iowa	223	4,405,365	4,078,167	3,418,723	500,111	25,111	73,643	7,656	52,923	1,200	325,998
Missouri	190	9,746,600	9,299,495	7,525,558	522,980	19,605	1,055,946	7,168	168,238	56,933	390,172
North Dakota	42	873,111	835,504	715,386	76,506	2,394	28,643	1,725	10,850	5	37,602
South Dakota	77	1,162,522	1,095,922	937,193	102,205	3,286	24,933	3,999	24,306	12,476	54,124
Nebraska	174	2,802,614	2,678,240	2,241,643	231,700	15,077	101,540	3,867	84,413	3,904	120,470
Kansas	176	3,020,154	2,909,012	2,314,985	293,196	15,262	188,350	6,009	91,210	7,865	103,277
SOUTH ATLANTIC:											
Delaware, District of Columbia, and Maryland	56	5,230,604	5,146,534	4,319,619	586,373	144,660	54,747	1,235	39,900	4,758	79,312
Virginia	67	805,022	794,858	565,006	146,573	1,888	37,057	1,645	42,689	585	9,579
West Virginia	58	1,167,583	1,148,089	921,114	108,432	1,635	59,787	10,712	46,409	....	19,494
North Carolina	94	1,458,786	1,404,167	1,070,442	102,062	1,860	113,319	693	115,791	2,094	52,525
South Carolina	61	4,499,800	4,265,983	2,693,071	128,706	3,668	1,390,321	4,405	45,812	198,280	35,537
Georgia	126	1,968,599	1,881,985	1,302,228	91,436	6,747	276,952	315	204,307	12,715	73,899
Florida	50	1,361,201	1,338,781	1,152,944	130,447	6,614	11,474	3,769	33,533	....	22,420
EAST SOUTH CENTRAL:											
Kentucky	89	2,754,115	2,683,137	2,041,648	466,917	18,084	78,496	4,238	73,754	4,502	66,476
Tennessee	90	2,448,218	2,408,762	1,695,155	182,019	3,853	204,495	8,555	314,685	....	39,456
Alabama	69	1,257,720	1,234,540	984,779	117,217	9,180	75,800	1,881	45,683	....	23,180
Mississippi	82	1,167,787	1,146,583	870,733	155,420	8,383	67,150	2,000	42,897	4,370	16,834
WEST SOUTH CENTRAL:											
Arkansas	74	1,053,763	1,016,664	826,968	69,272	4,886	29,304	4,019	82,215	....	37,099
Louisiana	50	2,278,754	2,251,102	1,835,548	324,300	34,464	24,165	982	31,643	10,054	17,598
Oklahoma	130	2,357,950	2,287,329	1,854,748	243,868	4,564	65,908	15,918	102,323	44,963	25,658
Texas	253	6,783,972	6,654,616	5,729,136	368,232	24,497	424,175	6,001	102,575	421	128,935
MOUNTAIN:											
Montana	29	3,883,410	3,292,385	3,062,191	143,692	6,835	74,441	1,852	3,374	334,387	256,638
Idaho	38	1,615,940	1,580,082	1,274,624	109,267	2,334	165,324	6,936	21,597	4,875	30,983
Wyoming	20	607,095	595,465	523,382	56,368	2,431	11,651	1,455	178	1,017	10,613
Colorado	73	4,791,340	4,626,693	3,760,180	285,589	20,332	540,326	6,775	13,491	40,111	124,536
New Mexico	21	497,895	488,422	398,453	25,947	489	61,296	905	1,332	3,858	5,615
Arizona	16	1,173,186	1,128,862	979,918	44,693	3,308	99,989	954	....	2,510	41,814
Utah	45	1,549,265	1,530,060	1,231,328	39,545	1,771	224,561	12,609	20,246	880	18,325
Nevada	8	618,942	607,597	569,462	20,852	2,283	15,000	....	....	....	11,345
PACIFIC:											
Washington	70	3,087,721	2,976,297	2,436,225	416,444	45,808	60,288	2,648	14,884	19,479	91,945
Oregon	66	1,422,703	1,380,785	1,183,505	133,105	3,857	43,759	7,722	8,837	7,404	34,514
California	112	27,685,573	26,461,154	19,941,719	1,606,055	87,175	4,763,032	9,340	53,833	603,203	621,216

Table 57.—COMMERCIAL CENTRAL ELECTRIC STATIONS—INCOME, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

DIVISION AND STATE.	Number of stations.	INCOME.								
		Gross income.	Electric service.						Interest and dividends from investments.	All other income.
			Total.	Commercial light, heat, and power.	Municipal street lighting.	Municipal building lighting.	Current sold to other public service corporations.	Estimated value of free service.		
UNITED STATES	3,659	$278,896,610	$264,317,150	$205,973,946	$24,852,137	$2,278,522	$30,698,901	$513,644	$4,869,226	$9,710,234
GEOGRAPHIC DIVISIONS:										
New England	311	27,778,263	26,657,472	20,492,151	3,759,303	352,980	1,987,049	65,989	231,288	889,503
Middle Atlantic	567	91,181,552	85,921,962	65,725,802	9,463,802	1,279,715	9,220,797	231,846	2,529,181	2,730,409
East North Central	786	59,799,662	55,888,687	43,253,084	4,305,938	146,355	8,122,846	60,464	564,274	3,346,701
West North Central	678	24,946,539	23,730,309	19,180,674	1,950,711	110,249	2,450,894	37,781	244,944	971,286
South Atlantic	308	13,639,654	13,153,340	9,968,487	1,093,365	162,086	1,906,628	22,774	217,832	268,482
East South Central	202	6,153,632	6,023,620	4,718,175	836,380	35,195	417,196	16,674	8,872	121,140
West South Central	385	11,078,636	10,828,036	9,259,910	940,791	65,529	534,886	26,920	55,438	195,162
Mountain	211	14,308,681	13,429,311	11,462,521	705,759	37,252	1,192,293	31,486	387,622	491,748
Pacific	211	30,009,991	28,684,413	21,913,142	1,796,088	89,161	4,866,312	19,710	629,775	695,803
NEW ENGLAND:										
Maine	75	2,038,013	1,735,191	1,272,212	165,587	5,552	281,909	9,931	72,967	229,855
New Hampshire	56	2,302,631	2,175,658	1,236,649	267,745	13,823	656,176	1,265	75,614	51,359
Vermont	48	1,061,086	1,031,174	850,407	94,594	6,081	28,803	51,289	....	29,912
Massachusetts	87	15,013,562	14,740,509	11,673,376	2,245,982	285,377	534,182	1,592	14,935	258,118
Rhode Island	7	2,294,628	2,194,451	1,608,817	439,790	9,527	136,317	....	12,604	87,573
Connecticut	38	5,068,343	4,780,489	3,850,690	545,605	32,620	349,662	1,912	55,168	232,686
MIDDLE ATLANTIC:										
New York	272	56,618,990	52,605,611	42,018,699	4,454,714	1,001,342	5,089,848	41,008	2,203,976	1,809,403
New Jersey	56	10,816,549	10,462,106	7,204,681	1,699,941	198,590	1,331,792	27,102	31,234	323,209
Pennsylvania	239	23,746,013	22,854,245	16,502,422	3,309,147	79,783	2,799,157	163,736	293,971	597,797
EAST NORTH CENTRAL:										
Ohio	186	10,297,613	9,945,996	8,250,024	1,346,055	21,484	313,448	14,985	245,006	106,611
Indiana	130	6,335,268	6,071,467	4,887,874	763,800	18,570	391,231	9,992	28,960	234,841
Illinois	170	27,639,832	24,989,798	18,732,297	1,172,116	41,786	5,023,304	20,295	135,428	2,514,606
Michigan	127	9,864,363	9,518,774	7,343,935	455,717	39,799	1,673,404	5,919	20,559	325,030
Wisconsin	173	5,662,586	5,362,652	4,038,954	568,250	24,716	721,459	9,273	134,321	165,613
WEST NORTH CENTRAL:										
Minnesota	91	5,859,001	5,614,964	4,119,300	464,717	36,933	986,657	7,357	165,301	78,736
Iowa	159	3,738,647	3,472,242	2,933,636	437,194	21,961	71,795	7,656	1,200	265,205
Missouri	125	8,941,729	8,521,947	6,977,661	462,471	18,851	1,055,796	7,168	54,193	365,589
North Dakota	33	750,378	719,624	624,565	62,813	1,878	28,643	1,725	5	30,749
South Dakota	64	1,015,577	952,811	825,731	94,917	3,231	24,933	3,999	12,476	50,290
Nebraska	112	2,245,368	2,143,078	1,822,577	203,397	13,233	100,004	3,867	3,904	98,386
Kansas	94	2,395,839	2,305,643	1,877,204	225,202	14,162	183,066	6,009	7,865	82,331
SOUTH ATLANTIC:										
Delaware, District of Columbia, and Maryland	43	5,053,370	4,971,133	4,218,920	571,247	144,560	35,171	1,235	4,758	77,479
Virginia	53	520,318	510,279	419,902	66,292	1,434	21,006	1,645	585	9,454
West Virginia	52	1,109,575	1,090,381	911,589	106,932	1,635	59,513	10,712	....	19,194
North Carolina	46	852,818	801,993	608,697	78,839	1,321	112,443	693	2,094	48,731
South Carolina	39	4,260,076	4,028,100	2,527,637	102,600	3,137	1,390,321	4,405	197,680	34,296
Georgia	42	1,210,989	1,137,931	770,213	84,216	6,487	276,700	315	12,715	60,343
Florida	33	632,508	613,523	511,529	83,239	3,512	11,474	3,769	....	18,985
EAST SOUTH CENTRAL:										
Kentucky	73	2,508,254	2,442,619	1,884,819	459,299	17,859	76,404	4,238	4,502	61,133
Tennessee	60	1,919,225	1,887,218	1,499,830	171,319	3,424	204,090	8,555	....	32,007
Alabama	34	984,422	964,299	775,806	104,524	7,584	74,504	1,881	....	20,123
Mississippi	35	741,731	729,484	557,720	101,238	6,328	62,198	2,000	4,370	7,877
WEST SOUTH CENTRAL:										
Arkansas	56	795,190	762,841	660,332	67,400	4,286	26,804	4,019	....	32,349
Louisiana	27	2,009,170	1,984,768	1,634,346	292,793	32,482	24,165	982	10,054	14,348
Oklahoma	67	1,934,526	1,866,233	1,550,796	229,813	4,564	65,142	15,918	44,963	23,330
Texas	235	6,339,750	6,214,194	5,414,436	350,785	24,197	418,775	6,001	421	125,135
MOUNTAIN:										
Montana	27	3,812,303	3,226,342	3,005,641	138,237	6,171	74,441	1,852	334,387	251,574
Idaho	35	1,538,596	1,502,838	1,218,977	109,267	2,334	165,324	6,936	4,875	30,883
Wyoming	18	595,227	583,597	513,812	54,248	2,431	11,651	1,455	1,017	10,613
Colorado	62	4,692,333	4,528,086	3,683,484	277,957	19,544	540,326	6,775	40,111	124,136
New Mexico	18	477,277	467,804	380,097	25,017	489	61,296	905	3,858	5,615
Arizona	16	1,173,186	1,128,862	979,918	44,693	3,308	99,989	954	2,510	41,814
Utah	28	1,403,703	1,387,071	1,113,264	36,172	760	224,266	12,609	864	15,768
Nevada	7	616,056	604,711	567,328	20,168	2,215	15,000	....	....	11,345
PACIFIC:										
Washington	60	1,638,574	1,559,019	1,354,974	138,880	2,274	60,243	2,648	19,479	60,076
Oregon	54	1,310,383	1,268,725	1,093,837	119,865	3,542	43,759	7,722	7,404	34,254
California	97	27,061,034	25,856,669	19,464,331	1,537,343	83,345	4,762,310	9,340	602,892	601,473

TABLE 58.—MUNICIPAL CENTRAL ELECTRIC STATIONS—INCOME, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

DIVISION AND STATE.	Number of stations.	INCOME.								
		Gross income.	Electric service.						Interest and dividends from investments.	All other income.
			Total.	Commercial light, heat, and power.	Municipal street lighting.	Municipal building lighting.	Current sold to other public service corporations.	Estimated value of free service.		
UNITED STATES	1,562	$23,218,989	$22,663,708	$15,226,520	$2,421,089	$225,989	$320,759	$4,469,351	$22,223	$533,058
GEOGRAPHIC DIVISIONS:										
New England	57	1,856,506	1,799,738	1,335,970	152,571	25,706	24,152	261,339	3,566	53,202
Middle Atlantic	102	1,369,651	1,336,759	751,557	192,605	8,178	2,284	382,135	235	32,657
East North Central	474	7,654,814	7,501,769	4,307,333	1,003,337	115,698	228,564	1,846,837	14,755	138,290
West North Central	399	4,001,668	3,813,230	2,929,769	342,128	14,024	10,257	517,052	2,740	185,698
South Atlantic	204	2,851,941	2,827,057	2,055,937	200,664	4,986	37,029	528,441	600	24,284
East South Central	128	1,474,208	1,449,402	874,140	85,193	4,305	8,745	477,019	....	24,806
West South Central	122	1,395,808	1,381,675	986,490	64,881	2,882	8,666	318,756	....	14,128
Mountain	39	428,392	420,255	337,017	20,194	2,531	295	60,218	16	8,121
Pacific	37	2,186,006	2,133,823	1,648,307	359,516	47,679	767	77,554	311	51,872
NEW ENGLAND:										
Maine	4	80,495	79,895	13,181	2,417	....	....	64,297	....	600
New Hampshire	3	25,632	25,075	20,411	4,464	200	....	....	....	557
Vermont	13	167,275	151,623	113,690	27,257	510	6,945	3,221	507	15,145
Massachusetts	30	1,293,347	1,255,954	956,155	76,164	21,817	7,997	193,821	3,022	34,371
Rhode Island	1	10,548	10,548	6,648	3,900	....	....		....	....
Connecticut	6	279,209	276,643	225,885	38,369	3,179	9,210	....	37	2,529
MIDDLE ATLANTIC:										
New York	49	599,983	583,389	369,908	101,625	5,295	184	106,377	235	16,359
New Jersey	8	127,818	125,407	72,578	37,048	....	....	15,781	....	2,411
Pennsylvania	45	641,850	627,963	309,071	53,932	2,883	2,100	259,977	....	13,887
EAST NORTH CENTRAL:										
Ohio	118	1,607,498	1,568,632	946,952	154,726	12,512	900	453,542	37	38,829
Indiana	71	1,375,955	1,346,017	989,649	122,081	3,067	1,780	229,440	216	29,722
Illinois	99	2,405,465	2,386,321	961,545	187,199	20,997	208,230	1,008,350	11,383	7,761
Michigan	108	1,653,893	1,608,257	979,600	414,762	73,393	6,094	134,408	2,238	43,398
Wisconsin	78	612,003	592,542	429,587	124,569	5,729	11,560	21,097	881	18,580
WEST NORTH CENTRAL:										
Minnesota	104	1,078,840	1,032,235	837,655	101,424	6,605	1,439	85,112	....	46,605
Iowa	64	666,718	605,925	485,087	62,917	3,150	1,848	52,923	....	60,793
Missouri	65	804,871	777,548	547,897	60,509	754	150	168,238	2,740	24,583
North Dakota	9	122,733	115,880	90,821	13,693	516	....	10,850	....	6,853
South Dakota	13	146,945	143,111	111,462	7,288	55	....	24,306	....	3,834
Nebraska	62	557,246	535,162	419,066	28,303	1,844	1,536	84,413	....	22,084
Kansas	82	624,315	603,369	437,781	67,994	1,100	5,284	91,210	....	20,946
SOUTH ATLANTIC:										
Delaware, District of Columbia, and Maryland	13	177,234	175,401	100,699	15,126	100	19,576	39,900	....	1,833
Virginia	14	284,704	284,579	145,104	80,281	454	16,051	42,689	....	125
West Virginia	6	58,008	57,708	9,525	1,500	....	274	46,409	....	300
North Carolina	48	605,968	602,174	461,745	23,223	539	876	115,791	....	3,794
South Carolina	22	239,724	237,883	165,434	26,106	531	....	45,812	600	1,241
Georgia	84	757,610	744,054	532,015	7,220	260	252	204,307	....	13,556
Florida	17	728,693	725,258	641,415	47,208	3,102	....	33,533	....	3,435
EAST SOUTH CENTRAL:										
Kentucky	16	245,861	240,518	156,829	7,618	225	2,092	73,754	....	5,343
Tennessee	30	528,993	521,544	195,325	10,700	429	405	314,685	....	7,449
Alabama	35	273,298	270,241	208,973	12,693	1,596	1,296	45,683	....	3,057
Mississippi	47	426,056	417,099	313,013	54,182	2,055	4,952	42,897	....	8,957
WEST SOUTH CENTRAL:										
Arkansas	18	258,573	253,823	166,636	1,872	600	2,500	82,215	....	4,750
Louisiana	23	269,584	266,334	201,202	31,507	1,982	....	31,643	....	3,250
Oklahoma	63	423,424	421,096	303,952	14,055	....	766	102,323	....	2,328
Texas	18	444,222	440,422	314,700	17,447	300	5,400	102,575	....	3,800
MOUNTAIN:										
Montana	2	71,107	66,043	56,550	5,455	664	....	3,374	....	5,064
Idaho	3	77,344	77,244	55,647	....	....	....	21,597	....	100
Wyoming	2	11,868	11,868	9,570	2,120	....	....	178	....	....
Colorado	11	99,007	98,607	76,696	7,632	788	....	13,491	....	400
New Mexico	3	20,618	20,618	18,356	930	....	....	1,332	....	....
Utah	17	145,562	142,989	118,064	3,373	1,011	295	20,246	16	2,557
Nevada	1	2,886	2,886	2,134	684	68	....	....	....	....
PACIFIC:										
Washington	10	1,449,147	1,417,278	1,081,251	277,564	43,534	45	14,884	....	31,869
Oregon	12	112,320	112,060	89,668	13,240	315	....	8,837	....	260
California	15	624,539	604,485	477,388	68,712	3,830	722	53,833	311	19,743

TABLE 59.—COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—

	DIVISION AND STATE.	Number of stations.	EXPENSES.				
			Aggregate.	Fuel.	Electric current and electric power purchased.	Rent of offices, conduits, underground and water privileges.	Supplies, materials, salaries, and wages, and all other miscellaneous expense, not olsewhere specified.
1	UNITED STATES	5,221	$234,419,478	$34,748,754	$18,074,344	$4,279,596	$91,847,508
	GEOGRAPHIC DIVISIONS:						
2	New England	368	21,414,431	3,165,590	1,394,330	342,355	9,136,705
3	Middle Atlantic	669	71,821,417	8,570,870	5,982,590	2,567,763	27,186,433
4	East North Central	1,260	53,414,485	9,982,296	2,933,041	607,180	22,092,732
5	West North Central	1,077	22,939,987	4,582,050	2,135,944	203,437	8,329,977
6	South Atlantic	512	12,126,351	1,592,015	1,831,265	127,182	4,451,571
7	East South Central	330	5,857,329	1,111,029	131,697	40,554	2,630,092
8	West South Central	507	9,165,847	2,383,832	311,664	57,660	3,960,732
9	Mountain	250	11,400,235	755,084	1,032,516	133,513	4,306,193
10	Pacific	248	26,279,396	2,605,988	2,321,297	199,952	9,753,073
	NEW ENGLAND:						
11	Maine	79	1,577,938	46,823	106,367	28,691	664,507
12	New Hampshire	59	1,596,152	192,294	45,210	14,840	651,075
13	Vermont	61	824,443	88,650	33,809	17,551	386,747
14	Massachusetts	117	11,651,739	1,866,063	774,871	233,430	5,161,731
15	Rhode Island	8	1,654,848	276,715	59,250	11,805	771,672
16	Connecticut	44	4,109,311	695,045	374,823	36,038	1,500,973
	MIDDLE ATLANTIC:						
17	New York	321	44,297,869	3,780,858	4,722,622	1,924,084	15,948,642
18	New Jersey	64	9,348,864	1,896,366	111,991	62,669	3,583,049
19	Pennsylvania	284	18,174,684	2,893,646	1,147,977	581,010	7,654,742
	EAST NORTH CENTRAL:						
20	Ohio	304	8,722,293	1,922,131	90,527	60,453	3,311,092
21	Indiana	201	6,028,909	1,455,877	232,334	39,493	2,403,844
22	Illinois	269	23,557,887	3,812,211	1,209,028	200,274	10,601,505
23	Michigan	235	9,784,138	1,539,632	832,065	240,170	3,994,210
24	Wisconsin	251	5,321,258	1,252,445	509,087	66,790	1,782,081
	WEST NORTH CENTRAL:						
25	Minnesota	195	5,580,525	699,572	955,205	62,648	1,794,465
26	Iowa	223	3,328,740	918,222	210,648	29,119	1,398,418
27	Missouri	190	7,484,853	1,239,272	707,573	71,712	2,479,600
28	North Dakota	42	714,294	207,336	15,403	1,774	272,530
29	South Dakota	77	965,763	259,662	12,881	7,347	354,513
30	Nebraska	174	2,239,542	621,858	61,540	17,444	959,225
31	Kansas	176	2,626,270	636,128	172,694	13,393	1,071,226
	SOUTH ATLANTIC:						
32	Delaware, District of Columbia, and Maryland	56	4,056,055	316,314	396,365	84,115	1,470,290
33	Virginia	67	567,459	106,650	19,828	4,283	271,291
34	West Virginia	58	897,843	178,403	102,050	7,457	379,065
35	North Carolina	94	1,046,217	136,620	213,528	4,961	413,485
36	South Carolina	61	2,850,661	216,894	1,017,640	6,537	744,816
37	Georgia	126	1,655,420	327,482	74,748	18,077	645,913
38	Florida	50	1,052,696	309,652	7,106	1,752	526,711
	EAST SOUTH CENTRAL:						
39	Kentucky	89	2,244,906	384,145	36,201	19,141	1,042,359
40	Tennessee	90	1,753,875	248,133	68,408	6,939	763,254
41	Alabama	69	980,169	211,409	3,764	10,700	428,019
42	Mississippi	82	878,379	267,342	23,324	3,774	396,460
	WEST SOUTH CENTRAL:						
43	Arkansas	74	749,029	214,526	3,570	4,625	359,576
44	Louisiana	50	1,604,019	238,023	208,790	3,308	620,298
45	Oklahoma	130	1,888,706	474,202	3,772	14,342	815,879
46	Texas	253	4,924,093	1,457,081	95,532	35,385	2,164,979
	MOUNTAIN:						
47	Montana	29	2,411,668	87,699	102,595	6,161	852,682
48	Idaho	38	1,537,260	8,478	107,829	25,369	477,539
49	Wyoming	20	445,789	87,187		4,520	254,772
50	Colorado	73	3,997,760	279,096	450,962	62,854	1,465,021
51	New Mexico	21	449,516	103,768	48,006	4,411	171,135
52	Arizona	16	923,258	146,326	106,558	7,567	324,128
53	Utah	45	1,206,729	10,757	215,460	4,727	557,442
54	Nevada	8	428,255	31,773	1,106	17,904	203,474
	PACIFIC:						
55	Washington	70	2,270,132	101,515	371,516	19,999	1,045,774
56	Oregon	66	1,205,738	102,054	73,792	9,896	476,180
57	California	112	22,803,526	2,402,419	1,875,989	170,057	8,231,119

EXPENSES, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

EXPENSES—continued.											
Taxes.						Interest on funded and floating debt.	Injuries and damages.	Insurance.	Charges for depreciation.	Charges for sinking fund.	
Total.	Real and personal property.	Capital stock.	Federal corporation.	Earnings.	Miscellaneous.						
$13,147,338	$8,048,291	$997,012	$558,706	$2,598,338	$944,991	$48,302,900	$1,200,989	$2,320,151	$18,843,863	$1,654,035	1
2,005,523	1,184,916	654,902	68,404	16,828	80,473	3,012,631	48,556	372,096	1,679,730	256,915	2
4,041,031	2,384,205	257,966	214,089	646,592	538,179	15,563,759	333,509	660,239	6,805,122	110,101	3
3,054,689	2,243,632	3,941	104,786	658,687	43,643	8,251,919	360,125	524,701	4,950,649	657,162	4
1,063,683	677,591	6,837	38,438	260,859	79,958	4,474,467	109,366	237,149	1,623,581	180,333	5
493,471	304,371	23,796	27,894	100,229	37,181	2,624,907	49,917	103,418	650,263	202,342	6
319,372	195,721	25,128	9,599	34,585	54,339	1,345,067	36,454	74,943	159,961	8,160	7
496,612	357,480	9,348	19,878	35,190	74,716	1,419,123	65,980	116,752	342,742	10,750	8
545,518	495,072	7,758	32,148	4,522	6,018	4,039,908	103,221	71,040	370,648	42,594	9
1,127,439	205,303	7,336	43,470	840,846	30,484	7,571,128	93,861	159,813	2,261,167	185,678	10
82,075	78,022	434	3,060	...	539	568,895	9,015	16,001	41,080	14,484	11
117,565	104,061	8,990	4,433	71	10	433,995	10,460	31,048	83,287	16,378	12
26,030	24,398	370	809	302	151	208,667	2,789	15,365	37,500	7,335	13
1,449,081	808,527	583,174	37,914	400	19,066	858,267	10,648	245,274	994,876	57,498	14
156,469	77,609	95	10,388	16,055	52,322	179,373	3,338	21,336	145,784	29,106	15
174,303	92,299	61,819	11,800	...	8,385	763,434	12,306	43,072	377,203	132,114	16
3,015,150	2,057,065	24,839	125,676	332,506	475,064	8,580,777	230,869	410,061	5,596,134	88,672	17
364,225	173,977	10,744	26,935	148,345	4,224	2,977,408	55,700	44,248	245,750	7,458	18
661,656	153,163	222,383	61,478	165,741	58,891	4,005,574	46,940	205,930	963,238	13,971	19
682,799	521,444	898	19,837	125,783	14,837	1,147,079	61,411	63,660	1,361,166	21,975	20
225,781	142,352	460	12,291	45,599	25,079	1,126,200	28,507	58,893	449,326	8,654	21
1,405,329	865,594	1,664	50,162	486,049	1,860	3,314,163	203,328	298,226	1,901,480	552,343	22
492,498	475,567	919	14,837	...	1,175	1,851,392	42,282	55,439	695,157	41,293	23
248,282	238,675	...	7,659	1,256	692	813,076	24,597	48,483	543,520	32,897	24
259,383	209,991	3,688	8,865	36,776	63	1,446,538	16,421	52,072	169,773	124,448	25
105,032	86,131	1,521	4,797	12,229	354	472,142	12,710	34,035	144,217	4,197	26
427,481	172,384	630	17,078	159,948	77,441	1,551,990	49,681	81,144	835,768	40,632	27
28,609	28,083	...	526	...	...	112,523	2,559	11,065	59,595	2,900	28
25,631	24,575	222	471	...	363	235,675	3,926	12,366	51,472	2,290	29
127,494	73,660	776	3,403	48,832	823	227,949	16,942	16,501	189,423	1,166	30
90,053	82,767	...	3,298	3,074	914	427,650	7,127	29,966	173,333	4,700	31
243,000	104,599	16,212	9,245	91,979	20,965	1,050,224	28,273	23,247	352,307	91,920	32
15,003	12,619	270	605	1,217	292	115,844	719	10,166	22,605	1,070	33
29,030	25,260	1,200	1,553	51	966	136,720	3,884	15,458	43,294	2,482	34
22,346	14,716	965	5,546	705	414	214,365	4,580	8,621	20,216	7,495	35
123,032	88,183	4,941	10,335	5,752	13,821	577,204	8,412	23,335	79,008	53,783	36
52,155	50,915	160	140	427	513	452,176	2,469	14,767	22,041	45,592	37
8,905	8,079	48	470	98	210	78,374	1,580	7,824	110,792	...	38
141,936	70,140	3,701	3,261	25,349	39,485	452,927	16,309	29,901	119,287	2,700	39
99,089	79,844	1,353	4,674	313	12,905	523,106	4,043	12,134	25,209	3,500	40
51,582	19,780	19,628	1,377	8,923	1,874	239,793	8,342	19,338	6,522	700	41
26,765	25,957	446	287	...	75	129,241	7,760	13,570	8,883	1,260	42
21,056	17,655	445	63	...	2,893	110,730	3,858	11,654	16,434	3,000	43
139,194	65,336	207	4,291	6,610	62,750	304,957	9,463	16,234	63,752	...	44
116,522	98,122	165	4,474	11,847	1,914	353,509	3,058	33,564	70,858	3,000	45
219,840	176,367	8,531	11,050	16,733	7,159	649,927	49,601	55,300	191,698	4,750	46
142,218	125,943	9	13,296	1,703	1,267	1,098,214	22,402	11,799	68,627	19,271	47
50,202	43,963	3,379	2,231	108	521	774,260	22,775	9,457	61,351	...	48
14,719	12,699	25	555	1,440	...	63,524	3,750	5,238	12,079	...	49
189,671	175,342	2,001	9,644	221	2,463	1,439,544	16,661	25,328	55,334	13,289	50
13,023	11,329	1,203	491	...	...	83,220	649	6,278	19,026	...	51
40,583	38,234	62	1,703	...	584	215,421	16,088	9,490	57,097	...	52
67,197	64,855	140	2,157	...	45	232,768	19,383	827	97,134	1,034	53
27,905	22,707	939	2,071	1,050	1,138	132,957	1,513	2,623	...	9,000	54
62,197	61,319	135	521	80	142	482,292	9,605	14,578	161,656	1,000	55
46,485	42,448	175	563	2,044	1,255	437,657	1,428	17,554	39,692	1,000	56
1,018,757	101,536	7,026	42,386	838,722	29,087	6,651,179	82,828	127,681	2,059,819	183,678	57

Table 60.—COMMERCIAL CENTRAL ELECTRIC STATIONS—

	DIVISION AND STATE.	Number of stations.	EXPENSES.				
			Aggregate.	Fuel.	Electric current and electric power purchased.	Rent of offices, conduits, underground and water privileges.	Supplies, materials, salaries and wages, and all other miscellaneous expense not elsewhere specified.
1	UNITED STATES	3,659	$217,502,313	$30,373,445	$16,912,612	$4,214,120	$83,194,081
	GEOGRAPHIC DIVISIONS:						
2	New England	311	19,960,887	2,878,156	1,262,828	319,641	8,480,558
3	Middle Atlantic	567	70,799,455	8,292,538	5,942,909	2,566,722	26,622,821
4	East North Central	786	47,940,189	8,612,861	2,612,324	587,730	19,063,231
5	West North Central	678	19,824,954	3,480,162	2,035,620	196,244	6,831,153
6	South Atlantic	308	10,080,424	1,031,294	1,671,062	122,503	3,475,769
7	East South Central	202	4,855,061	808,623	118,757	39,032	2,091,418
8	West South Central	385	8,087,574	2,025,092	266,373	55,567	3,441,599
9	Mountain	211	11,113,312	701,658	1,007,949	132,767	4,152,018
10	Pacific	211	24,840,457	2,543,061	1,994,790	193,914	9,035,514
	NEW ENGLAND:						
11	Maine	75	1,521,129	44,300	104,867	28,691	617,877
12	New Hampshire	56	1,578,503	189,701	43,910	14,732	643,543
13	Vermont	48	697,631	67,776	27,332	16,531	324,199
14	Massachusetts	87	10,620,760	1,643,235	679,586	212,391	4,711,316
15	Rhode Island	7	1,648,794	275,457	59,250	11,805	767,685
16	Connecticut	38	3,894,010	657,687	347,883	35,491	1,415,938
	MIDDLE ATLANTIC:						
17	New York	272	43,839,868	3,644,185	4,706,335	1,923,630	15,711,487
18	New Jersey	56	9,249,612	1,872,413	108,735	62,369	3,528,343
19	Pennsylvania	239	17,709,975	2,775,940	1,127,839	580,723	7,382,991
	EAST NORTH CENTRAL:						
20	Ohio	186	7,546,896	1,593,505	53,759	57,643	2,706,994
21	Indiana	130	5,106,111	1,143,130	196,794	36,116	1,901,441
22	Illinois	170	21,889,335	3,591,902	1,072,183	191,289	9,565,567
23	Michigan	127	8,580,242	1,195,642	801,466	237,622	3,336,929
24	Wisconsin	173	4,817,605	1,088,682	488,122	65,060	1,552,300
	WEST NORTH CENTRAL:						
25	Minnesota	91	4,747,351	405,010	903,454	62,210	1,419,493
26	Iowa	159	2,804,309	725,385	204,771	28,513	1,112,647
27	Missouri	125	6,860,194	1,012,301	706,968	67,371	2,167,078
28	North Dakota	33	614,024	163,230	14,736	1,714	235,185
29	South Dakota	64	852,992	223,510	4,881	6,987	307,577
30	Nebraska	112	1,826,531	457,176	34,983	16,589	783,902
31	Kansas	94	2,119,553	493,550	165,827	12,860	805,271
	SOUTH ATLANTIC:						
32	Delaware, District of Columbia, and Maryland	43	3,934,301	271,686	393,698	83,920	1,415,837
33	Virginia	53	372,737	78,288	15,211	4,218	183,195
34	West Virginia	52	853,449	165,226	102,050	7,457	349,422
35	North Carolina	46	640,436	40,249	125,193	4,521	244,977
36	South Carolina	39	2,689,713	177,348	985,748	6,195	677,173
37	Georgia	42	1,108,986	134,518	44,385	14,590	390,491
38	Florida	33	480,802	163,979	4,777	1,602	214,674
	EAST SOUTH CENTRAL:						
39	Kentucky	73	2,063,403	343,866	36,103	18,546	911,671
40	Tennessee	60	1,489,761	173,112	60,108	6,628	620,661
41	Alabama	34	766,521	139,348	3,764	10,260	328,964
42	Mississippi	35	535,376	152,297	18,782	3,598	230,122
	WEST SOUTH CENTRAL:						
43	Arkansas	56	586,916	158,276	3,570	4,340	273,698
44	Louisiana	27	1,396,189	139,943	208,790	2,983	522,447
45	Oklahoma	67	1,482,274	337,493	3,172	13,039	626,070
46	Texas	235	4,622,195	1,389,380	50,841	35,205	2,019,384
	MOUNTAIN:						
47	Montana	27	2,354,067	65,127	102,595	6,161	828,734
48	Idaho	35	1,493,871	8,478	97,558	25,174	457,024
49	Wyoming	18	437,104	85,087		4,520	250,062
50	Colorado	62	3,926,649	264,055	442,612	62,854	1,426,094
51	New Mexico	18	430,846	97,227	48,006	4,411	162,268
52	Arizona	16	923,258	146,326	106,558	7,567	324,128
53	Utah	28	1,120,767	3,585	210,620	4,185	500,624
54	Nevada	7	426,750	31,773		17,895	203,084
	PACIFIC:						
55	Washington	60	1,348,871	98,192	166,437	14,697	550,218
56	Oregon	54	1,143,165	94,571	73,792	9,440	433,073
57	California	97	22,348,421	2,350,298	1,754,561	169,777	8,052,223

EXPENSES, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

EXPENSES—continued.											
Taxes.						Interest on funded and floating debt.	Injuries and damages.	Insurance.	Charges for depreciation.	Charges for sinking fund.	
Total.	Real and personal property.	Capital stock.	Federal corporation.	Earnings.	Miscellaneous.						
$13.117,198	$8,027,176	$997,012	$558,706	$2,598,338	$935,966	$46,864,763	$1,156,668	$2,159,446	$17,989.527	$1,520,453	1
1,995,870	1,183,602	654,902	68,404	16,828	72,134	2,875,326	45,085	347,930	1,539,872	215,621	2
4,039,082	2,382,459	257,966	214,089	646,592	537,976	15,474,817	332,732	650,871	6,769,489	107,474	3
3,037,748	2,227,111	3,941	104,786	658,687	43,223	7,900,378	348,562	483,264	4,678,519	615,572	4
1,062,426	676,397	6,837	38,438	260,859	79,895	4,234,053	109,098	203,052	1,526,202	146,944	5
493,358	304,258	23,796	27,894	100,229	37,181	2,428,668	47,932	85,901	523,870	200,067	6
319,243	195,592	25,128	9,599	34,585	54,339	1,228,431	34,554	62,959	149,744	2,300	7
496,526	357,394	9,348	19,878	35,190	74,716	1,299,263	60,719	104,079	332,106	6,250	8
545,518	495,072	7,758	32,148	4,522	6,018	4,001,415	103,221	67,617	359,589	41,560	9
1,127,427	205,291	7,336	43,470	840,846	30,484	7,422,412	74,765	153,773	2,110,136	184,665	10
82,075	78,022	454	3,060	....	539	566,745	9,015	14,995	41,080	11,484	11
117,565	104,061	8,990	4,433	71	10	429,621	10,460	30,726	81,927	16,378	12
24,914	23,282	370	809	302	151	184,188	2,781	13,348	32,562	4,000	13
1,448,756	808,437	583,174	37,914	400	18,831	774,198	7,426	227,247	872,824	43,781	14
156,361	77,501	95	10,388	16,055	52,322	178,916	3,338	21,092	145,784	29,106	15
166,199	92,299	61,819	11,800	....	281	741,658	12,065	40,522	365,695	110,872	16
3,013,834	2,055,749	24,839	125,676	332,506	475,064	8,546,322	230,747	405,168	5,569,488	88,672	17
364,225	173,977	10,744	26,935	148,345	4,224	2,969,683	55,045	44,078	238,663	6,058	18
661,023	152,733	222,383	61,478	165,741	58,688	3,958,812	46,940	201,625	961,338	12,744	19
682,799	521,444	898	19,837	125,783	14,837	1,037,214	61,381	52,170	1,298,781	2,650	20
225,548	142,119	460	12,291	45,599	25,079	1,089,415	25,922	52,358	434,653	734	21
1,390,102	850,367	1,664	50,162	486,049	1,860	3,251,857	198,588	286,822	1,792,682	548,343	22
491,017	474,506	919	14,837	....	755	1,746,182	41,346	48,004	645,258	36,776	23
248,282	238,675	....	7,659	1,256	692	775,710	21,325	43,910	507,145	27,069	24
259,320	209,991	3,688	8,865	36,776	....	1,392,072	16,189	41,771	148,033	99,799	25
105,032	86,131	1,521	4,797	12,229	354	445,334	12,700	29,634	137,596	2,697	26
427,356	172,259	630	17,078	159,948	77,441	1,497,781	49,681	72,572	820,204	38,882	27
28,559	28,033	....	526	....	....	106,193	2,559	9,391	52,057	400	28
25,631	24,575	222	471	....	363	230,088	3,926	11,322	39,070	....	29
127,494	73,660	776	3,403	48,832	823	197,487	16,942	13,424	177,368	1,166	30
89,034	81,748	....	3,298	3,074	914	365,098	7,101	24,938	151,874	4,000	31
242,987	104,586	16,212	9,245	91,979	20,965	1,039,471	27,098	22,204	345,960	91,440	32
14,903	12,519	270	605	1,217	292	65,380	719	8,212	2,611	....	33
29,030	25,260	1,200	1,553	51	966	135,533	3,884	15,071	43,294	2,482	34
22,346	14,716	965	5,546	705	414	170,573	4,064	6,931	14,387	7,195	35
123,032	88,183	4,941	10,335	5,752	13,821	558,071	8,412	21,368	79,008	53,358	36
52,155	50,915	160	140	427	513	397,358	2,369	8,659	18,869	45,592	37
8,905	8,079	48	470	98	210	62,282	1,386	3,456	19,741	....	38
141,807	70,011	3,701	3,261	25,349	39,485	448,826	16,309	26,788	117,287	2,200	39
99,089	79,844	1,353	4,674	313	12,905	493,745	3,993	9,156	23,269	....	40
51,582	19,780	19,628	1,377	8,923	1,874	204,713	7,142	17,526	3,122	100	41
26,765	25,957	446	287	....	75	81,147	7,110	9,489	6,066	....	42
20,970	17,569	445	63	....	2,893	100,353	3,608	10,603	8,498	3,000	43
139,194	65,336	207	4,291	6,610	62,750	295,949	9,463	13,668	63,752	....	44
116,522	98,122	165	4,474	11,847	1,914	281,994	3,058	29,768	68,158	3,000	45
219,840	176,367	8,531	11,050	16,733	7,159	620,967	44,590	50,040	191,698	250	46
142,218	125,943	9	13,296	1,703	1,267	1,095,956	22,402	10,227	61,376	19,271	47
50,202	43,963	3,379	2,231	108	521	765,010	22,775	9,397	58,253	....	48
14,719	12,699	25	555	1,440	....	62,024	3,750	4,863	12,079	....	49
189,671	175,342	2,001	9,644	221	2,463	1,431,765	16,661	24,314	55,334	13,289	50
13,023	11,329	1,203	491	....	....	80,160	649	6,076	19,026	....	51
40,583	38,234	62	1,703	....	584	215,421	16,088	9,490	57,097	....	52
67,197	64,855	140	2,157	....	45	218,122	19,383	627	96,424	....	53
27,905	22,707	939	2,071	1,050	1,138	132,957	1,513	2,623	....	9,000	54
62,197	61,319	135	521	80	142	372,951	1,588	10,386	71,205	1,000	55
46,473	42,436	175	563	2,044	1,255	426,492	1,428	17,204	39,692	1,000	56
1,018,757	101,536	7,026	42,386	838,722	29,087	6,622,969	71,749	126,183	1,999,239	182,665	57

Table 61.—MUNICIPAL CENTRAL ELECTRIC STATIONS—EXPENSES, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

DIVISION AND STATE.	Number of stations.	EXPENSES.												
		Aggregate.	Fuel.	Electric current and electric power purchased.	Rent of offices, conduits, underground and water privileges.	Supplies, materials, salaries and wages, and all other miscellaneous expense not elsewhere specified.	Taxes.			Interest on funded and floating debt.	Injuries and damages.	Insurance.	Charges for depreciation.	Charges for sinking fund.
							Total.	Real and personal property.	Miscellaneous.					
United States	1,562	$16,917,165	$4,375,309	$1,161,732	$65,476	$8,653,427	$30,140	$21,115	$9,025	$1,438,137	$44,321	$160,705	$854,336	$133,582
Geographic divisions:														
New England	57	1,453,544	287,434	131,502	22,714	656,147	9,653	1,314	8,339	137,305	3,471	24,166	139,858	41,294
Middle Atlantic	102	1,021,962	278,332	39,681	1,041	563,612	1,949	1,746	203	88,942	777	9,368	35,633	2,627
East North Central	474	5,474,296	1,369,435	320,717	19,450	3,029,501	16,941	16,521	420	351,532	11,563	41,437	272,130	41,590
West North Central	399	3,115,033	1,101,888	100,324	7,193	1,498,824	1,257	1,194	63	240,414	268	34,097	97,379	33,389
South Atlantic	204	2,045,927	560,721	160,203	4,679	975,802	113	113	....	196,239	1,985	17,517	126,393	2,275
East South Central	128	1,002,268	302,406	12,940	1,522	538,674	129	129	....	116,636	1,900	11,984	10,217	5,860
West South Central	122	1,078,273	358,740	45,291	2,093	519,133	86	86	....	119,860	5,261	12,673	10,636	4,500
Mountain	39	286,923	53,426	24,567	746	154,175	....	....	....	38,493	....	3,423	11,059	1,034
Pacific	37	1,438,939	62,927	326,507	6,038	717,559	12	12	....	148,716	19,096	6,040	151,031	1,013
New England:														
Maine	4	56,809	2,523	1,500	....	46,630	....	....	....	2,150	....	1,006	....	3,000
New Hampshire	3	17,589	2,593	1,300	108	7,532	....	....	....	4,374	....	322	1,360	....
Vermont	13	126,812	20,874	6,477	1,020	62,548	1,116	1,116	....	24,479	8	2,017	4,938	3,335
Massachusetts	30	1,030,979	222,828	95,285	21,039	450,415	325	90	235	84,069	3,222	18,027	122,052	13,717
Rhode Island	1	6,054	1,258	....	....	3,987	108	108	....	457	....	244	....	....
Connecticut	6	215,301	37,358	26,940	547	85,035	8,104	....	8,104	21,776	241	2,550	11,508	21,242
Middle Atlantic:														
New York	49	458,001	136,673	16,287	454	237,155	1,316	1,316	....	34,455	122	4,893	26,646	....
New Jersey	8	99,252	23,953	3,256	300	54,706	....	....	....	7,725	655	170	7,087	1,400
Pennsylvania	45	464,709	117,706	20,138	287	271,751	633	430	203	46,762	....	4,305	1,900	1,227
East North Central:														
Ohio	118	1,175,397	328,626	36,768	2,810	604,098	....	....	....	109,865	30	11,490	62,385	19,325
Indiana	71	922,798	312,747	35,540	3,377	502,403	233	233	....	36,785	2,585	6,535	14,673	7,920
Illinois	99	1,668,552	220,309	196,845	8,985	1,035,938	15,227	15,227	....	62,306	4,740	11,404	108,798	4,000
Michigan	108	1,203,896	343,990	30,599	2,548	657,281	1,481	1,061	420	105,210	936	7,435	49,899	4,517
Wisconsin	78	503,653	163,763	20,965	1,730	229,781	....	....	....	37,366	3,272	4,573	36,375	5,828
West North Central:														
Minnesota	104	833,174	294,562	51,751	438	374,972	63	....	63	54,466	232	10,301	21,740	24,649
Iowa	64	524,431	192,837	5,877	606	285,771	....	....	....	26,808	10	4,401	6,621	1,500
Missouri	65	624,659	226,971	605	4,341	312,522	125	125	....	54,209	....	8,572	15,564	1,750
North Dakota	9	100,270	44,106	667	60	37,345	50	50	....	6,330	....	1,674	7,538	2,500
South Dakota	13	112,771	36,152	8,000	360	46,936	....	....	....	5,587	....	1,044	12,402	2,290
Nebraska	62	413,011	164,682	26,557	855	175,323	....	....	....	30,462	....	3,077	12,055	....
Kansas	82	506,717	142,578	6,867	533	265,955	1,019	1,019	....	62,552	26	5,028	21,459	700
South Atlantic:														
Delaware, District of Columbia, and Maryland	13	121,754	44,628	2,667	195	54,453	13	13	....	10,753	1,175	1,043	6,347	480
Virginia	14	194,722	28,362	4,617	65	88,096	100	100	....	50,464	....	1,954	19,994	1,070
West Virginia	6	44,394	13,177	....	....	29,643	....	....	....	1,187	....	387	....	....
North Carolina	48	405,781	96,371	88,335	440	168,508	....	....	....	43,792	516	1,690	5,829	300
South Carolina	22	160,948	39,546	31,892	342	67,643	....	....	....	19,133	....	1,967	....	425
Georgia	84	546,434	192,964	30,363	3,487	255,422	....	....	....	54,818	100	6,108	3,172	....
Florida	17	571,894	145,673	2,329	150	312,037	....	....	....	16,092	194	4,368	91,051	....
East South Central:														
Kentucky	16	181,503	40,279	98	595	130,688	129	129	....	4,101	....	3,113	2,000	500
Tennessee	30	264,114	75,021	8,300	311	142,593	....	....	....	29,361	50	2,978	2,000	3,500
Alabama	35	213,648	72,061	....	440	99,055	....	....	....	35,080	1,200	1,812	3,400	600
Mississippi	47	343,003	115,045	4,542	176	166,338	....	....	....	48,094	650	4,081	2,817	1,260
West South Central:														
Arkansas	18	162,113	56,250	....	285	85,878	86	86	....	10,377	250	1,051	7,936	....
Louisiana	23	207,830	98,080	....	325	97,851	....	....	....	9,008	....	2,566	....	....
Oklahoma	63	406,432	136,709	600	1,303	189,809	....	....	....	71,515	....	3,796	2,700	....
Texas	18	301,898	67,701	44,691	180	145,595	....	....	....	28,960	5,011	5,260	....	4,500
Mountain:														
Montana	2	57,601	22,572	....	....	23,948	....	....	....	2,258	....	1,572	7,251	....
Idaho	3	43,389	....	10,271	195	20,515	....	....	....	9,250	....	60	3,098	....
Wyoming	2	8,685	2,100	....	....	4,710	....	....	....	1,500	....	375	....	....
Colorado	11	71,111	15,041	8,350	....	38,927	....	....	....	7,779	....	1,014	....	....
New Mexico	3	18,670	6,541	....	....	8,867	....	....	....	3,060	....	202	....	....
Utah	17	85,962	7,172	4,840	542	56,818	....	....	....	14,646	....	200	710	1,034
Nevada	1	1,505	....	1,106	9	390	....	....	....	....	....	....	....	....
Pacific:														
Washington	10	921,261	3,323	205,079	5,302	495,556	....	....	....	109,341	8,017	4,192	90,451	....
Oregon	12	62,573	7,483	....	456	43,107	12	12	....	11,165	....	350	....	....
California	15	455,105	52,121	121,428	280	178,896	....	....	....	28,210	11,079	1,498	60,580	1,013

TABLE 62.—COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—

	DIVISION AND STATE.	Number of stations.	PRIMARY POWER.													
			Aggregate.		Total steam.		Steam engines.									
							Total.		500 horsepower or under.		Over 500 horsepower and under 2,000 horsepower.		2,000 horsepower and under 5,000 horsepower.		5,000 horsepower and over.	
			Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.
1	UNITED STATES	5,221	11,893	7,528,648	7,844	4,946,532	6,809	1,892,076	6,136	1,037,655	565	508,373	92	240,794	16	105,254
	GEOGRAPHIC DIVISIONS:															
2	New England	368	1,121	735,244	560	519,426	401	168,721	319	75,061	68	56,660	14	37,000	......	......
3	Middle Atlantic	669	2,149	2,013,317	1,419	1,340,485	1,188	492,401	962	199,329	192	182,108	26	62,410	8	48,554
4	East North Central	1,260	2,879	1,690,999	2,025	1,404,897	1,765	438,121	1,614	262,300	133	120,683	17	48,638	1	6,500
5	West North Central	1,077	1,968	601,750	1,328	465,027	1,232	250,443	1,177	172,843	45	36,900	7	19,700	3	21,000
6	South Atlantic	512	1,015	621,114	663	274,488	597	123,729	577	95,079	15	11,250	4	10,700	1	6,700
7	East South Central	330	583	215,731	523	177,021	477	93,990	451	70,497	25	21,147	1	2,346	......	......
8	West South Central	507	966	233,563	780	208,206	724	144,291	681	97,354	37	31,937	6	15,000	......	......
9	Mountain	250	582	426,783	268	108,769	220	53,917	200	33,294	18	16,123	2	4,500	......	......
10	Pacific	248	630	990,147	278	448,213	205	126,463	155	31,898	32	31,565	15	40,500	3	22,500
	NEW ENGLAND:															
11	Maine	79	236	89,683	58	19,610	55	14,540	52	12,590	3	1,950	......	......	......	......
12	New Hampshire	59	182	84,228	56	25,386	44	18,386	36	8,211	7	7,175	1	3,000	......	......
13	Vermont	61	141	50,363	40	14,996	31	7,455	30	6,705	1	750	......	......	......	......
14	Massachusetts	117	350	350,780	270	323,128	188	98,963	133	30,478	42	34,485	13	34,000	......	......
15	Rhode Island	8	36	50,499	18	46,934	8	6,450	1	100	7	6,350	......	......	......	......
16	Connecticut	44	176	109,691	118	89,372	75	22,927	67	16,977	8	5,950	......	......	......	......
	MIDDLE ATLANTIC:															
17	New York	321	1,024	1,157,809	553	638,932	458	196,413	377	69,313	61	55,140	13	33,460	7	38,500
18	New Jersey	64	290	239,514	251	235,585	214	103,899	153	34,474	53	51,675	8	17,750	......	......
19	Pennsylvania	284	835	615,994	615	465,968	516	192,089	432	95,542	78	75,293	5	11,200	1	10,054
	EAST NORTH CENTRAL:															
20	Ohio	304	632	337,272	506	317,160	450	126,788	405	67,113	34	30,065	11	29,610	......	......
21	Indiana	201	459	185,503	352	159,888	289	70,120	269	48,445	19	15,175	......	......	1	6,500
22	Illinois	269	703	645,631	576	605,227	516	129,002	472	76,512	41	41,490	3	11,000	......	......
23	Michigan	235	591	377,182	319	250,477	266	62,947	240	38,161	24	20,626	2	4,160	......	......
24	Wisconsin	251	494	145,411	272	72,145	244	49,264	228	32,069	15	13,327	1	3,868	......	......
	WEST NORTH CENTRAL:															
25	Minnesota	195	377	148,111	247	63,184	229	38,609	220	28,909	7	5,500	2	4,200	......	......
26	Iowa	223	418	77,131	308	67,444	293	50,497	277	37,547	16	12,950	......	......	......	......
27	Missouri	190	328	182,095	301	177,721	284	78,764	266	39,364	13	11,400	2	7,000	3	21,000
28	North Dakota	42	82	16,169	74	15,851	72	14,651	70	13,251	2	1,400	......	......	......	......
29	South Dakota	77	151	27,748	50	16,003	41	6,950	41	6,950	......	......	......	......	......	......
30	Nebraska	174	291	52,168	156	42,452	141	20,908	140	20,158	1	750	......	......	......	......
31	Kansas	176	321	98,328	192	82,372	172	40,064	163	26,664	6	4,900	3	8,500	......	......
	SOUTH ATLANTIC:															
32	Delaware	14	33	4,651	22	3,575	22	3,575	22	3,575	......	......	......	......	......	......
33	Maryland	41	107	54,563	74	50,517	67	29,101	62	11,701	......	......	4	10,700	1	6,700
34	District of Columbia	1	10	53,864	10	53,864	5	4,200	......	......	5	4,200	......	......	......	......
35	Virginia	67	132	59,585	66	15,120	57	7,870	57	7,870	......	......	......	......	......	......
36	West Virginia	58	126	43,185	88	34,064	77	19,684	70	14,934	7	4,750	......	......	......	......
37	North Carolina	94	144	64,983	89	14,952	85	12,582	84	11,782	1	800	......	......	......	......
38	South Carolina	61	159	218,496	68	39,486	58	8,437	58	8,437	......	......	......	......	......	......
39	Georgia	126	205	87,951	156	35,274	145	24,519	143	23,019	2	1,500	......	......	......	......
40	Florida	50	99	33,836	90	27,636	81	13,761	81	13,761	......	......	......	......	......	......
	EAST SOUTH CENTRAL:															
41	Kentucky	89	177	81,767	171	81,191	153	33,529	140	23,337	13	10,192	......	......	......	......
42	Tennessee	90	166	68,994	130	40,799	118	22,407	113	16,061	4	4,000	1	2,346	......	......
43	Alabama	69	111	34,473	94	24,574	85	15,559	82	12,459	3	3,100	......	......	......	......
44	Mississippi	82	129	30,497	128	30,457	121	22,495	116	18,640	5	3,855	......	......	......	......
	WEST SOUTH CENTRAL:															
45	Arkansas	74	130	25,860	115	22,599	107	16,681	105	15,481	2	1,200	......	......	......	......
46	Louisiana	50	95	27,165	86	26,175	82	23,050	71	9,510	9	8,740	2	4,800	......	......
47	Oklahoma	130	239	53,922	194	45,821	187	44,054	175	27,364	8	6,490	4	10,200	......	......
48	Texas	253	502	126,616	385	113,611	348	60,506	330	44,999	18	15,507	......	......	......	......
	MOUNTAIN:															
49	Montana	29	103	115,710	38	12,750	32	5,250	32	5,250	......	......	......	......	......	......
50	Idaho	38	77	56,375	14	4,525	11	2,775	10	2,025	1	750	......	......	......	......
51	Wyoming	20	57	11,596	45	10,162	39	6,026	39	6,026	......	......	......	......	......	......
52	Colorado	73	162	134,004	94	56,919	75	22,839	63	9,449	10	8,890	2	4,500	......	......
53	New Mexico	21	50	11,015	32	8,428	26	5,848	24	4,415	2	1,433	......	......	......	......
54	Arizona	16	37	22,075	33	12,775	27	9,469	22	4,419	5	5,050	......	......	......	......
55	Utah	45	69	60,588	6	1,000	6	1,000	6	1,000	......	......	......	......	......	......
56	Nevada	8	27	15,420	6	2,210	4	710	4	710	......	......	......	......	......	......
	PACIFIC:															
57	Washington	70	122	95,884	55	18,128	43	7,633	41	5,783	2	1,850	......	......	......	......
58	Oregon	66	123	46,015	54	15,879	49	10,379	47	8,829	2	1,550	......	......	......	......
59	California	112	385	848,248	169	414,206	113	108,451	67	17,286	28	28,165	15	40,500	3	22,500

PRIMARY POWER, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

PRIMARY POWER—continued.																						
Steam turbines.										Water wheels and turbines.										Gas and oil engines.		
Total.		500 horsepower or under.		Over 500 horsepower and under 2,000 horsepower.		2,000 horsepower and under 5,000 horsepower.		5,000 horsepower and over.		Total.		500 horsepower or under.		Over 500 horsepower and under 2,000 horsepower.		2,000 horsepower and under 5,000 horsepower.		5,000 horsepower and over.		Total.		
Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	
1,035	3,054,456	193	53.715	477	470,178	202	604,587	163	1,925,976	2,933	2,471,081	1,995	333,795	638	594,440	147	448,760	153	1,094,086	1,116	111,035	1
159	350,705	21	5,464	94	100,164	31	97,375	13	147,702	511	208,501	405	74,650	91	83,751	13	40,100	2	10,000	50	7,317	2
231	848,084	37	11,485	91	89,334	50	151,802	53	595,463	559	646,268	377	64,401	104	100,567	24	65,800	54	415,500	171	26,564	3
260	966,776	36	11,890	135	135,328	37	110,743	52	708,815	636	263,982	486	76,407	124	86,375	24	86,800	2	14,400	218	22,120	4
96	214,584	27	5,905	40	37,060	18	54,242	11	117,377	224	110,720	192	24,806	25	18,414	2	4,500	5	63,000	416	26,003	5
66	150,759	12	3,590	32	32,022	14	35,383	8	79,764	298	340,528	176	29,518	69	75,110	17	46,500	36	189,400	54	6,098	6
46	83,031	13	2,704	16	15,607	15	49,220	2	15,500	47	37,630	34	4,230	8	11,800	5	21,600	......	......	13	1,080	7
56	63,915	20	4,955	25	22,251	8	19,709	3	17,000	35	8,678	31	5,978	4	2,700	......	......	......	......	151	16,679	8
48	54,852	18	4,487	19	17,165	10	26,550	1	6,650	294	315,319	151	27,164	109	114,355	20	71,800	14	102,000	20	2,695	9
73	321,750	9	3,235	25	21,247	19	59,563	20	237,705	329	539,455	143	26,641	104	101,368	42	111,660	40	299,786	23	2,479	10
3	5,070	......	......	2	2,320	1	2,750	......	......	175	69,938	136	24,693	35	29,845	2	5,400	2	10,000	3	135	11
12	7,000	3	500	9	6,500	......	......	......	......	115	56,937	95	17,837	12	11,100	8	28,000	......	......	11	1,905	12
9	7,541	2	670	7	6,871	......	......	......	......	99	35,272	79	16,285	19	16,987	1	2,000	......	......	2	95	13
82	224,165	8	1,700	46	46,502	19	55,928	9	120,035	58	24,480	43	7,461	13	12,319	2	4,700	......	......	22	3,172	14
10	40,484	......	......	4	6,150	4	17,667	2	16,667	13	2,440	13	2,440	......	......	......	......	......	......	5	1,125	15
43	66,445	8	2,594	26	31,821	7	21,030	2	11,000	51	19,434	39	5,934	12	13,500	......	......	......	......	7	885	16
95	442,519	18	4,281	31	27,918	19	53,253	27	357,067	405	512,406	265	48,297	68	67,309	24	65,800	48	331,000	66	6,471	17
37	131,686	2	900	16	17,456	10	32,430	9	80,900	18	1,569	18	1,569	......	......	......	......	......	......	21	2,360	18
99	273,879	17	6,304	44	43,960	21	66,119	17	157,496	136	132,293	94	14,535	36	33,258	......	......	6	84,500	84	17,733	19
56	190,372	10	3,025	23	21,789	10	29,633	13	135,925	33	8,860	30	4,260	3	4,600	......	......	......	......	93	11,252	20
63	89,768	9	3,500	41	36,218	10	28,300	3	21,750	90	23,915	86	19,315	4	4,600	......	......	......	......	17	1,700	21
60	476,225	......	......	26	28,355	7	22,730	27	425,140	92	37,362	44	7,332	48	30,030	......	......	......	......	35	3,042	22
53	187,530	8	3,500	29	33,980	7	24,050	9	126,000	245	125,079	168	26,734	63	40,345	12	43,600	2	14,400	27	1,626	23
28	22,881	9	1,865	16	14,986	3	6,030	......	......	176	68,766	158	18,766	6	6,800	12	43,200	......	......	46	4,500	24
18	24,575	4	1,125	11	10,650	2	4,800	1	8,000	76	80,172	62	9,872	9	7,300	......	......	5	63,000	54	4,755	25
15	16,947	5	1,199	8	7,705	1	2,681	1	5,362	58	7,029	56	5,329	2	1,700	......	......	......	......	52	2,658	26
17	98,957	2	625	3	2,998	6	20,734	6	74,600	5	1,902	4	902	1	1,000	......	......	......	......	22	2,472	27
2	1,200	1	450	1	750	......	......	......	......	......	......	......	......	......	......	......	......	......	......	8	318	28
9	9,053	4	670	2	1,716	3	6,667	......	......	15	6,913	5	490	10	6,423	......	......	......	......	86	4,832	29
15	21,544	7	1,033	4	3,086	3	12,010	1	5,415	44	5,884	42	4,458	2	1,426	......	......	......	......	91	3,832	30
20	42,308	4	803	11	10,155	3	7,350	2	24,000	26	8,820	23	3,755	1	565	2	4,500	......	......	103	7,136	31
......	......	......	......	......	......	......	......	......	......	8	826	8	826	......	......	......	......	......	......	3	250	32
7	21,416	......	......	3	3,266	3	8,050	1	10,100	25	3,223	25	3,223	......	......	......	......	......	......	8	823	33
5	49,664	......	......	......	......	......	......	5	49,664	......	......	......	......	......	......	......	......	......	......	......	......	34
9	7,250	......	......	9	7,250	......	......	......	......	63	44,280	48	8,680	8	6,600	3	9,000	4	20,000	3	185	35
11	14,380	2	410	5	3,970	4	10,000	......	......	14	6,036	8	1,366	6	4,670	......	......	......	......	24	3,085	36
4	2,370	2	900	2	1,470	......	......	......	......	52	49,951	36	5,451	8	6,500	2	5,000	6	33,000	3	80	37
10	31,049	2	300	3	3,416	3	7,333	2	20,000	88	178,555	23	5,815	35	39,640	8	18,700	22	114,400	3	455	38
11	10,755	5	1,855	5	6,900	1	2,000	......	......	45	51,957	28	4,157	10	14,000	3	11,800	4	22,000	4	720	39
9	13,875	1	125	5	5,750	3	8,000	......	......	3	5,700	......	......	2	3,700	1	2,000	......	......	6	500	40
18	47,662	3	387	7	7,425	6	24,350	2	15,500	......	......	......	......	......	......	......	......	......	......	6	576	41
12	18,392	3	452	3	3,250	6	14,690	......	......	32	27,750	25	2,950	2	3,200	5	21,600	......	......	4	445	42
9	9,015	5	1,675	3	2,840	1	4,500	......	......	15	9,880	9	1,280	6	8,600	......	......	......	......	2	19	43
7	7,962	2	190	3	2,092	2	5,680	......	......	......	......	......	......	......	......	......	......	......	......	1	40	44
8	5,918	2	635	6	5,283	......	......	......	......	10	3,040	8	1,540	2	1,500	......	......	......	......	5	221	45
4	3,125	1	125	3	3,000	......	......	......	......	......	......	......	......	......	......	......	......	......	......	9	990	46
7	1,767	6	1,017	1	750	......	......	......	......	7	2,135	7	2,135	......	......	......	......	......	......	38	5,966	47
37	53,105	11	3,178	15	13,218	8	19,709	3	17,000	18	3,503	16	2,303	2	1,200	......	......	......	......	99	9,502	48
6	7,500	3	800	1	700	2	6,000	......	......	64	102,885	22	5,272	27	27,213	9	34,400	6	36,000	1	75	49
3	1,750	2	1,000	1	750	......	......	......	......	63	51,850	34	5,725	25	23,125	2	6,000	2	17,000	......	......	50
6	4,136	3	800	3	3,336	......	......	......	......	11	1,334	11	1,334	......	......	......	......	......	......	1	100	51
19	34,080	3	470	7	6,410	8	20,550	1	6,650	67	77,005	40	7,005	20	18,000	2	8,000	5	44,000	1	80	52
6	2,580	4	581	2	1,999	......	......	......	......	9	817	9	817	......	......	......	......	......	......	9	1,770	53
6	3,306	3	836	3	2,470	......	......	......	......	4	9,300	1	300	......	......	3	9,000	......	......	......	......	54
......	......	......	......	......	......	......	......	......	......	63	59,588	30	6,451	28	33,737	4	14,400	1	5,000	......	......	55
2	1,500	......	......	2	1,500	......	......	......	......	13	12,540	4	260	9	12,280	......	......	......	......	8	670	56
12	10,495	5	1,660	5	4,169	2	4,666	......	......	64	77,591	44	7,741	10	10,050	3	6,800	7	53,000	3	165	57
5	5,500	......	......	4	2,833	1	2,667	......	......	60	29,802	36	4,957	23	19,845	......	......	1	5,000	9	334	58
56	305,755	4	1,575	16	14,245	16	52,230	20	237,705	205	432,062	63	13,943	71	71,473	39	104,860	32	241,786	11	1,980	59

TABLE 63.—COMMERCIAL CENTRAL ELECTRIC STATIONS—

	DIVISION AND STATE.	Number of stations.	PRIMARY POWER.													
			Aggregate.		Total steam.		Steam engines.									
							Total.		500 horsepower or under.		Over 500 horsepower and under 2,000 horsepower.		2,000 horsepower and under 5,000 horsepower.		5,000 horsepower and over.	
			Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.
1	UNITED STATES	3,659	9,317	6,969,320	5,820	4,539,866	4,898	1,585,583	4,252	752,702	538	486,833	92	240,794	16	105,254
	GEOGRAPHIC DIVISIONS:															
2	New England	311	997	689,240	483	483,612	341	154,177	261	61,917	66	55,260	14	37,000	......	......
3	Middle Atlantic	567	1,958	1,981,623	1,273	1,314,357	1,048	468,408	824	176,836	190	180,608	26	62,410	8	48,554
4	East North Central	786	2,070	1,510,373	1,378	1,269,337	1,160	339,583	1,018	171,152	124	113,293	17	48,638	1	6,500
5	West North Central	678	1,328	517,217	856	392,139	775	184,761	728	112,861	37	31,200	7	19,700	3	21,000
6	South Atlantic	308	719	554,269	403	215,385	354	85,851	334	57,201	15	11,250	4	10,700	1	6,700
7	East South Central	202	384	179,925	334	142,679	293	63,823	270	43,080	22	18,397	1	2,346	......	......
8	West South Central	385	761	201,793	598	178,180	550	118,620	508	72,483	36	31,137	6	15,000	......	......
9	Mountain	211	526	416,586	240	104,714	193	49,997	173	29,374	18	16,123	2	4,500	......	......
10	Pacific	211	574	918,294	255	439,463	184	120,363	136	27,798	30	29,565	15	40,500	3	22,500
	NEW ENGLAND:															
11	Maine	75	227	87,195	56	18,760	53	13,690	50	11,740	3	1,950	......	......	......	......
12	New Hampshire	56	177	82,983	53	24,541	41	17,541	33	7,366	7	7,175	1	3,000	......	......
13	Vermont	48	119	43,597	35	13,096	28	7,025	27	6,275	1	750	......	......	......	......
14	Massachusetts	87	285	324,703	218	299,206	148	89,341	94	21,606	41	33,735	13	34,000	......	......
15	Rhode Island	7	35	50,399	17	46,834	7	6,350	......	......	7	6,350	......	......	......	......
16	Connecticut	38	154	100,363	104	81,175	64	20,230	57	14,930	7	5,300	......	......	......	......
	MIDDLE ATLANTIC:															
17	New York	272	941	1,144,308	492	628,486	403	188,102	322	61,002	61	55,140	13	33,460	7	38,500
18	New Jersey	56	275	236,761	240	233,104	203	101,418	142	31,993	53	51,675	8	17,750	......	......
19	Pennsylvania	239	742	600,554	541	452,767	442	178,888	360	83,841	76	73,793	5	11,200	1	10,054
	EAST NORTH CENTRAL:															
20	Ohio	186	440	299,466	338	282,914	290	100,152	248	42,967	31	27,575	11	29,610	......	......
21	Indiana	130	346	154,186	246	129,051	199	52,637	179	30,962	19	15,175	......	......	1	6,500
22	Illinois	170	508	594,630	435	582,506	376	107,031	335	57,041	38	38,990	3	11,000	......	......
23	Michigan	127	402	330,564	177	213,813	136	40,866	113	18,480	21	18,226	2	4,160	......	......
24	Wisconsin	173	374	131,527	182	61,053	159	38,897	143	21,702	15	13,327	1	3,868	......	......
	WEST NORTH CENTRAL:															
25	Minnesota	91	210	126,918	110	45,091	95	22,061	88	13,811	5	4,050	2	4,200	......	......
26	Iowa	159	314	63,763	230	55,941	216	39,394	201	26,994	15	12,400	......	......	......	......
27	Missouri	125	222	165,275	200	161,143	185	63,076	170	26,076	10	9,000	2	7,000	3	21,000
28	North Dakota	33	67	13,969	59	13,651	57	12,451	55	11,051	2	1,400	......	......	......	......
29	South Dakota	64	125	25,130	41	14,813	32	5,760	32	5,760	......	......	......	......	......	......
30	Nebraska	112	194	40,406	100	32,611	91	13,388	91	13,388	......	......	......	......	......	......
31	Kansas	94	196	81,756	116	68,889	99	28,631	91	15,781	5	4,350	3	8,500	......	......
	SOUTH ATLANTIC:															
32	Delaware	8	21	3,031	10	1,955	10	1,955	10	1,955	......	......	......	......	......	......
33	Maryland	34	95	50,409	65	46,568	60	27,752	55	10,352	......	......	4	10,700	1	6,700
34	District of Columbia	1	10	53,864	10	53,864	5	4,200	......	......	5	4,200	......	......	......	......
35	Virginia	53	101	48,379	51	9,720	47	6,570	47	6,570	......	......	......	......	......	......
36	West Virginia	52	118	41,490	82	32,534	71	18,154	64	13,404	7	4,750	......	......	......	......
37	North Carolina	46	84	55,128	39	6,078	37	5,178	36	4,378	1	800	......	......	......	......
38	South Carolina	39	130	214,516	40	35,566	30	4,517	30	4,517	......	......	......	......	......	......
39	Georgia	42	96	70,818	50	18,631	40	7,931	38	6,431	2	1,500	......	......	......	......
40	Florida	33	64	16,634	56	10,469	54	9,594	54	9,594	......	......	......	......	......	......
	EAST SOUTH CENTRAL:															
41	Kentucky	73	150	74,252	145	73,696	129	28,509	117	19,067	12	9,442	......	......	......	......
42	Tennessee	60	109	57,649	76	29,979	66	13,137	63	8,791	2	2,000	1	2,346	......	......
43	Alabama	34	67	28,054	55	19,034	46	10,019	43	6,919	3	3,100	......	......	......	......
44	Mississippi	35	58	19,970	58	19,970	52	12,158	47	8,303	5	3,855	......	......	......	......
	WEST SOUTH CENTRAL:															
45	Arkansas	56	99	19,880	85	16,769	78	11,701	76	10,501	2	1,200	......	......	......	......
46	Louisiana	27	53	21,290	48	20,665	46	18,665	35	5,125	9	8,740	2	4,800	......	......
47	Oklakoma	67	138	41,940	107	34,785	103	33,298	91	16,608	8	6,490	4	10,200	......	......
48	Texas	235	471	118,683	358	105,961	323	54,956	306	40,249	17	14,707	......	......	......	......
	MOUNTAIN:															
49	Montana	27	99	114,785	34	11,825	28	4,325	28	4,325	......	......	......	......	......	......
50	Idaho	35	71	55,275	14	4,525	11	2,775	10	2,025	1	750	......	......	......	......
51	Wyoming	18	52	11,320	41	9,922	35	5,786	35	5,786	......	......	......	......	......	......
52	Colorado	62	145	131,089	79	54,804	61	20,859	49	7,469	10	8,890	2	4,500	......	......
53	New Mexico	18	44	10,285	30	8,128	24	5,548	22	4,115	2	1,433	......	......	......	......
54	Arizona	16	37	22,075	33	12,775	27	9,469	22	4,419	5	5,050	......	......	......	......
55	Utah	28	51	56,337	3	525	3	525	3	525	......	......	......	......	......	......
56	Nevada	7	27	15,420	6	2,210	4	710	4	710	......	......	......	......	......	......
	PACIFIC:															
57	Washington	60	102	38,259	53	17,738	41	7,243	39	5,393	2	1,850	......	......	......	......
58	Oregon	54	107	41,342	50	15,324	45	9,824	43	8,274	2	1,550	......	......	......	......
59	California	97	365	838,693	152	406,401	98	103,296	54	14,131	26	26,165	15	40,500	3	22,500

PRIMARY POWER, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

PRIMARY POWER—continued.																						
Steam turbines.										Water wheels and turbines.										Gas and oil engines.		
Total.		500 horsepower or under.		Over 500 horsepower and under 2,000 horsepower.		2,000 horsepower and under 5,000 horsepower.		5,000 horsepower and over.		Total.		500 horsepower or under.		Over 500 horsepower and under 2,000 horsepower.		2,000 horsepower and under 5,000 horsepower.		5,000 horsepower and over.				
Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	
922	2,954,283	147	42,649	423	417,455	189	568,203	163	1,925,976	2,664	2,340,820	1,797	298,674	576	554,100	144	441,960	147	1,046,086	833	88,634	1
142	329,435	16	4,194	86	92,681	27	84,858	13	147,702	475	200,024	371	67,398	89	82,526	13	40,100	2	10,000	39	5,604	2
225	845,949	33	10,850	89	87,834	50	151,802	53	595,463	541	643,677	359	61,810	104	100,567	24	65,800	54	415,500	144	23,589	3
218	929,754	16	5,305	118	118,758	32	96,876	52	708,815	528	224,220	426	66,200	76	56,820	24	86,800	2	14,400	164	16,816	4
81	207,378	18	4,124	34	31,635	18	54,242	11	117,377	207	108,962	175	23,048	25	18,414	2	4,500	5	63,000	265	16,116	5
49	129,534	11	3,535	19	18,852	11	27,383	8	79,764	269	333,141	151	24,531	65	72,710	17	46,500	36	189,400	47	5,743	6
41	78,856	11	2,504	13	11,632	15	49,220	2	15,500	41	36,455	28	3,055	8	11,800	5	21,600	.....	.....	9	791	7
48	59,560	16	4,550	21	18,301	8	19,709	3	17,000	32	8,258	28	5,558	4	2,700	.....	.....	.....	.....	131	15,355	8
47	54,717	17	4,352	19	17,165	10	26,550	1	6,650	270	309,607	129	22,652	107	113,155	20	71,800	14	102,000	16	2,265	9
71	319,100	9	3,235	24	20,597	18	57,563	20	237,705	301	476,476	130	24,422	98	95,408	39	104,860	34	251,786	18	2,355	10
3	5,070	.....	.....	2	2,320	1	2,750	.....	.....	168	68,300	129	23,055	35	29,845	2	5,400	2	10,000	3	135	11
12	7,000	3	500	9	6,500	.....	.....	.....	.....	113	56,537	93	17,437	12	11,100	8	28,000	.....	.....	11	1,905	12
7	6,071	1	200	6	5,871	.....	.....	.....	.....	82	30,406	64	12,644	17	15,762	1	2,000	.....	.....	2	95	13
70	209,865	4	900	41	42,169	16	46,761	9	120,035	52	23,283	37	6,264	13	12,319	2	4,700	.....	.....	15	2,214	14
10	40,484	.....	.....	4	6,150	4	17,667	2	16,667	13	2,440	13	2,440	.....	.....	.....	.....	.....	.....	5	1,125	15
40	60,945	8	2,594	24	29,671	6	17,680	2	11,000	47	19,058	35	5,558	12	13,500	.....	.....	.....	.....	3	130	16
89	440,384	14	3,646	29	26,418	19	53,253	27	357,067	394	510,521	254	46,412	68	67,309	24	65,800	48	331,000	55	5,301	17
37	131,686	2	900	16	17,456	10	32,430	9	80,900	17	1,457	17	1,457	.....	.....	.....	.....	.....	.....	18	2,200	18
99	273,879	17	6,304	44	43,960	21	66,119	17	157,496	130	131,699	88	13,941	36	33,258	.....	.....	6	84,500	71	16,088	19
48	182,762	6	1,415	20	18,289	9	27,133	13	135,925	32	8,635	29	4,035	3	4,600	.....	.....	.....	.....	70	7,917	20
47	76,414	4	1,450	31	27,581	9	25,633	3	21,750	90	23,915	86	19,315	4	4,600	.....	.....	.....	.....	10	1,220	21
59	475,475	.....	.....	25	27,605	7	22,730	27	425,140	43	9,242	39	5,212	4	4,030	.....	.....	.....	.....	30	2,882	22
41	172,947	2	1,300	26	30,297	4	15,350	9	126,000	209	115,852	136	21,062	59	36,790	12	43,600	2	14,400	16	899	23
23	22,156	4	1,140	16	14,986	3	6,030	.....	.....	154	66,576	136	16,576	6	6,800	12	43,200	.....	.....	38	3,898	24
15	23,030	2	580	10	9,650	2	4,800	1	8,000	66	78,960	52	8,660	9	7,300	.....	.....	5	63,000	34	2,867	25
14	16,547	4	799	8	7,705	1	2,681	1	5,362	55	6,639	53	4,939	2	1,700	.....	.....	.....	.....	29	1,183	26
15	98,067	1	400	2	2,333	6	20,734	6	74,600	5	1,902	4	902	1	1,000	.....	.....	.....	.....	17	2,230	27
2	1,200	1	450	1	750	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8	318	28
9	9,053	4	670	2	1,716	3	6,667	.....	.....	15	6,913	5	490	10	6,423	.....	.....	.....	.....	69	3,404	29
9	19,223	3	462	2	1,336	3	12,010	1	5,415	40	5,728	38	4,302	2	1,426	.....	.....	.....	.....	54	2,067	30
17	40,258	3	763	9	8,145	3	7,350	2	24,000	26	8,820	23	3,755	1	565	2	4,500	.....	.....	54	4,047	31
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8	826	8	826	.....	.....	.....	.....	.....	.....	3	250	32
5	18,816	.....	.....	1	666	3	8,050	1	10,100	23	3,083	23	3,083	.....	.....	.....	.....	.....	.....	7	758	33
5	49,664	.....	.....	.....	.....	.....	.....	5	49,664	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	34
4	3,150	.....	.....	4	3,150	.....	.....	.....	.....	47	38,474	36	5,274	4	4,200	3	9,000	4	20,000	3	185	35
11	14,380	2	410	5	3,970	4	10,000	.....	.....	14	6,036	8	1,366	6	4,670	.....	.....	.....	.....	22	2,920	36
2	900	2	900	.....	.....	.....	.....	.....	.....	44	49,000	28	4,500	8	6,500	2	5,000	6	33,000	1	50	37
10	31,049	2	300	3	3,416	3	7,333	2	20,000	88	178,555	23	5,815	35	39,640	8	18,700	22	114,400	2	395	38
10	10,700	4	1,800	5	6,900	1	2,000	.....	.....	42	51,467	25	3,667	10	14,000	3	11,800	4	22,000	4	720	39
2	875	1	125	1	750	.....	.....	.....	.....	3	5,700	.....	.....	2	3,700	1	2,000	.....	.....	5	465	40
16	45,187	3	387	5	4,950	6	24,350	2	15,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	556	41
10	16,842	2	402	2	1,750	6	14,690	.....	.....	30	27,450	23	2,650	2	3,200	5	21,600	.....	.....	3	220	42
9	9,015	5	1,675	3	2,840	1	4,500	.....	.....	11	9,005	5	405	6	8,600	.....	.....	.....	.....	1	15	43
6	7,812	1	40	3	2,092	2	5,680	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	44
7	5,068	2	635	5	4,433	.....	.....	.....	.....	10	3,040	8	1,540	2	1,500	.....	.....	.....	.....	4	71	45
2	2,000	.....	.....	2	2,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	625	46
4	1,487	3	737	1	750	.....	.....	.....	.....	5	1,835	5	1,835	.....	.....	.....	.....	.....	.....	26	5,320	47
35	51,005	11	3,178	13	11,118	8	19,709	3	17,000	17	3,383	15	2,183	2	1,200	.....	.....	.....	.....	96	9,339	48
6	7,500	3	800	1	700	2	6,000	.....	.....	64	102,885	22	5,272	27	27,213	9	34,400	6	36,000	1	75	49
3	1,750	2	1,000	1	750	.....	.....	.....	.....	57	50,750	28	4,625	25	23,125	2	6,000	2	17,000	.....	.....	50
6	4,136	3	800	3	3,336	.....	.....	.....	.....	10	1,298	10	1,298	.....	.....	.....	.....	.....	.....	1	100	51
18	33,945	2	335	7	6,410	8	20,550	1	6,650	65	76,205	38	6,205	20	18,000	2	8,000	5	44,000	1	80	52
6	2,580	4	581	2	1,999	.....	.....	.....	.....	9	817	9	817	.....	.....	.....	.....	.....	.....	5	1,340	53
6	3,306	3	836	3	2,470	.....	.....	.....	.....	4	9,300	1	300	.....	.....	3	9,000	.....	.....	.....	.....	54
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	48	55,812	17	3,875	26	32,537	4	14,400	1	5,000	.....	.....	55
2	1,500	.....	.....	2	1,500	.....	.....	.....	.....	13	12,540	4	260	9	12,280	.....	.....	.....	.....	8	670	56
12	10,495	5	1,660	5	4,169	2	4,666	.....	.....	46	20,356	36	6,306	9	9,050	.....	.....	1	5,000	3	165	57
5	5,500	.....	.....	4	2,833	1	2,667	.....	.....	53	25,808	33	4,523	19	16,285	.....	.....	1	5,000	4	210	58
54	303,105	4	1,575	15	13,595	15	50,230	20	237,705	202	430,312	61	13,593	70	70,073	39	104,860	32	241,786	11	1,980	59

Table 64.—MUNICIPAL CENTRAL ELECTRIC STATIONS—PRIMARY

	DIVISION AND STATE	Number of stations.	PRIMARY POWER.									
			Aggregate.		Total steam.		Steam engines.					
							Total.		500 horsepower or under.		Over 500 horsepower and under 2,000 horsepower.	
			Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.
1	UNITED STATES	1,562	2,576	559,328	2,024	406,666	1,911	306,493	1,884	284,953	27	21,540
	GEOGRAPHIC DIVISIONS:											
2	New England	57	124	46,004	77	35,814	60	14,544	58	13,144	2	1,400
3	Middle Atlantic	102	191	31,694	146	26,128	140	23,993	138	22,493	2	1,500
4	East North Central	474	809	180,626	647	135,560	605	98,538	596	91,148	9	7,390
5	West North Central	399	640	84,533	472	72,888	457	65,682	449	59,982	8	5,700
6	South Atlantic	204	296	66,845	260	59,103	243	37,878	243	37,878	......	......
7	East South Central	128	199	35,806	189	34,342	184	30,167	181	27,417	3	2,750
8	West South Central	122	205	31,770	182	30,026	174	25,671	173	24,871	1	800
9	Mountain	39	56	10,197	28	4,055	27	3,920	27	3,920	......	......
10	Pacific	37	56	71,853	23	8,750	21	6,100	19	4,100	2	2,000
	NEW ENGLAND:											
11	Maine	4	9	2,488	2	850	2	850	2	850	......	......
12	New Hampshire	3	5	1,245	3	845	3	845	3	845	......	......
13	Vermont	13	22	6,766	5	1,900	3	430	3	430	......	......
14	Massachusetts	30	65	26,077	52	23,922	40	9,622	39	8,872	1	750
15	Rhode Island	1	1	100	1	100	1	100	1	100	......	......
16	Connecticut	6	22	9,328	14	8,197	11	2,697	10	2,047	1	650
	MIDDLE ATLANTIC:											
17	New York	49	83	13,501	61	10,446	55	8,311	55	8,311	......	......
18	New Jersey	8	15	2,753	11	2,481	11	2,481	11	2,481	......	......
19	Pennsylvania	45	93	15,440	74	13,201	74	13,201	72	11,701	2	1,500
	EAST NORTH CENTRAL:											
20	Ohio	118	192	37,806	168	34,246	160	26,636	157	24,146	3	2,490
21	Indiana	71	113	31,317	106	30,837	90	17,483	90	17,483	......	......
22	Illinois	99	195	51,001	141	22,721	140	21,971	137	19,471	3	2,500
23	Michigan	108	189	46,618	142	36,664	130	22,081	127	19,681	3	2,400
24	Wisconsin	78	120	13,884	90	11,092	85	10,367	85	10,367	......	......
	WEST NORTH CENTRAL:											
25	Minnesota	104	167	21,193	137	18,093	134	16,548	132	15,098	2	1,450
26	Iowa	64	104	13,368	78	11,503	77	11,103	76	10,553	1	550
27	Missouri	65	106	16,820	101	16,578	99	15,688	96	13,288	3	2,400
28	North Dakota	9	15	2,200	15	2,200	15	2,200	15	2,200	......	......
29	South Dakota	13	26	2,618	9	1,190	9	1,190	9	1,190	......	......
30	Nebraska	62	97	11,762	56	9,841	50	7,520	49	6,770	1	750
31	Kansas	82	125	16,572	76	13,483	73	11,433	72	10,883	1	550
	SOUTH ATLANTIC:											
32	Delaware	6	12	1,620	12	1,620	12	1,620	12	1,620	......	......
33	Maryland	7	12	4,154	9	3,949	7	1,349	7	1,349	......	......
34	Virginia	14	31	11,206	15	5,400	10	1,300	10	1,300	......	......
35	West Virginia	6	8	1,695	6	1,530	6	1,530	6	1,530	......	......
36	North Carolina	48	60	9,855	59	8,874	48	7,404	48	7,404	......	......
37	South Carolina	22	29	3,980	28	3,920	28	3,920	28	3,920	......	......
38	Georgia	84	109	17,133	106	16,643	105	16,588	105	16,588	......	......
39	Florida	17	35	17,202	34	17,167	27	4,167	27	4,167	......	......
	EAST SOUTH CENTRAL:											
40	Kentucky	16	27	7,515	26	7,495	24	5,020	23	4,270	1	750
41	Tennessee	30	57	11,345	54	10,820	52	9,270	50	7,270	2	2,000
42	Alabama	35	44	6,419	39	5,540	39	5,540	39	5,540	......	......
43	Mississippi	47	71	10,527	70	10,487	69	10,337	69	10,337	......	......
	WEST SOUTH CENTRAL:											
44	Arkansas	18	31	5,980	30	5,830	29	4,980	29	4,980	......	......
45	Louisiana	23	42	5,875	38	5,510	36	4,385	36	4,385	......	......
46	Oklahoma	63	101	11,982	87	11,036	84	10,756	84	10,756	......	......
47	Texas	18	31	7,933	27	7,650	25	5,550	24	4,750	1	800
	MOUNTAIN:											
48	Montana	2	4	925	4	925	4	925	4	925	......	......
49	Idaho	3	6	1,100	......	......	......	......	......	......	......	......
50	Wyoming	2	5	276	4	240	4	240	4	240	......	......
51	Colorado	11	17	2,915	15	2,115	14	1,980	14	1,980	......	......
52	New Mexico	3	6	730	2	300	2	300	2	300	......	......
53	Utah	17	18	4,251	3	475	3	475	3	475	......	......
54	Nevada	1	......	......	......	......	......	......	......	......	......	......
	PACIFIC:											
55	Washington	10	20	57,625	2	390	2	390	2	390	......	......
56	Oregon	12	16	4,673	4	555	4	555	4	555	......	......
57	California	15	20	9,555	17	7,805	15	5,155	13	3,155	2	2,000

POWER, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

PRIMARY POWER—continued.																				
Steam turbines.								Water wheels and turbines.										Gas and oil engines.		
Total.		500 horsepower or under.		Over 500 horsepower and under 2,000 horsepower.		2,000 horsepower and under 5,000 horsepower.		Total.		500 horsepower or under.		Over 500 horsepower and under 2,000 horsepower.		2,000 horsepower and under 5,000 horsepower.		5,000 horsepower and over.		Total.		
Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	
113	100,173	46	11,066	54	52,723	13	36,384	269	130,261	198	35,121	62	40,340	3	6,800	6	48,000	283	22,401	1
17	21,270	5	4,270	8	7,483	4	12,517	36	8,477	34	7,252	2	1,225	...	...	...	...	11	1,713	2
6	2,135	4	635	2	1,500	...	...	18	2,591	18	2,591	...	...	...	...	...	...	27	2,975	3
42	37,022	20	6,585	17	16,570	5	13,867	108	39,762	60	10,207	48	29,555	...	...	...	...	54	5,304	4
15	7,206	9	1,781	6	5,425	...	...	17	1,758	17	1,758	...	...	...	...	...	...	151	9,887	5
17	21,225	1	55	13	13,170	3	8,000	29	7,387	25	4,987	4	2,400	...	...	...	...	7	355	6
5	4,175	2	200	3	3,975	...	...	6	1,175	6	1,175	...	...	...	...	...	...	4	289	7
8	4,355	4	405	4	3,950	...	...	3	420	3	420	...	...	...	...	...	...	20	1,324	8
1	135	1	135	...	...	...	...	24	5,712	22	4,512	2	1,200	...	...	...	...	4	430	9
2	2,650	...	...	1	650	1	2,000	28	62,979	13	2,219	6	5,960	3	6,800	6	48,000	5	124	10
...	...	...	...	...	...	...	...	7	1,638	7	1,638	...	...	...	...	...	...	...	...	11
...	...	...	...	...	...	...	...	2	400	2	400	...	...	...	...	...	...	...	...	12
2	1,470	1	470	1	1,000	...	...	17	4,866	15	3,641	2	1,225	...	...	...	...	...	...	13
12	14,300	4	800	5	4,333	3	9,167	6	1,197	6	1,197	...	...	...	...	...	...	7	958	14
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	15
3	5,500	...	...	2	2,150	1	3,350	4	376	4	376	...	...	...	...	...	...	4	755	16
6	2,135	4	635	2	1,500	...	...	11	1,885	11	1,885	...	...	...	...	...	...	11	1,170	17
...	...	...	...	...	...	...	...	1	112	1	112	...	...	...	...	...	...	3	160	18
...	...	...	...	...	...	...	...	6	594	6	594	...	...	...	...	...	...	13	1,645	19
8	7,610	4	1,610	3	3,500	1	2,500	1	225	1	225	...	...	...	...	...	...	23	3,335	20
16	13,354	5	2,050	10	8,637	1	2,667	...	...	...	...	...	...	...	...	...	...	7	480	21
1	750	...	...	1	750	...	...	49	28,120	5	2,120	44	26,000	...	...	...	...	5	160	22
12	14,583	6	2,200	3	3,683	3	8,700	36	9,227	32	5,672	4	3,555	...	...	...	...	11	727	23
5	725	5	725	...	...	...	...	22	2,190	22	2,190	...	...	...	...	...	...	8	602	24
3	1,545	2	545	1	1,000	...	...	10	1,212	10	1,212	...	...	...	...	...	...	20	1,888	25
1	400	1	400	...	...	...	...	3	390	3	390	...	...	...	...	...	...	23	1,475	26
2	890	1	225	1	665	...	...	...	...	...	...	...	...	...	...	...	...	5	242	27
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	28
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	17	1,428	29
6	2,321	4	571	2	1,750	...	...	4	156	4	156	...	...	...	...	...	...	37	1,765	30
3	2,050	1	40	2	2,010	...	...	...	...	...	...	...	...	...	...	...	...	49	3,089	31
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	32
2	2,600	...	...	2	2,600	...	...	2	140	2	140	...	...	...	...	...	...	1	65	33
5	4,100	...	...	5	4,100	...	...	16	5,806	12	3,406	4	2,400	...	...	...	...	...	...	34
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	165	35
2	1,470	...	...	2	1,470	...	...	8	951	8	951	...	...	...	...	...	...	2	30	36
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	60	37
1	55	1	55	...	...	...	...	3	490	3	490	...	...	...	...	...	...	...	...	38
7	13,000	...	...	4	5,000	3	8,000	...	...	...	...	...	...	...	...	...	...	1	35	39
2	2,475	...	...	2	2,475	...	...	...	...	...	...	...	...	...	...	...	...	1	20	40
2	1,550	1	50	1	1,500	...	...	2	300	2	300	...	...	...	...	...	...	1	225	41
...	...	...	...	...	...	...	...	4	875	4	875	...	...	...	...	...	...	1	4	42
1	150	1	150	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	40	43
1	850	...	...	1	850	...	...	...	...	...	...	...	...	...	...	...	...	1	150	44
2	1,125	1	125	1	1,000	...	...	...	...	...	...	...	...	...	...	...	...	4	365	45
3	280	3	280	...	...	...	...	2	300	2	300	...	...	...	...	...	...	12	646	46
2	2,100	...	...	2	2,100	...	...	1	120	1	120	...	...	...	...	...	...	3	163	47
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	48
...	...	...	...	...	...	...	...	6	1,100	6	1,100	...	...	...	...	...	...	...	...	49
...	...	...	...	...	...	...	...	1	36	1	36	...	...	...	...	...	...	...	...	50
1	135	1	135	...	...	...	...	2	800	2	800	...	...	...	...	...	...	...	...	51
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	430	52
...	...	...	...	...	...	...	...	15	3,776	13	2,576	2	1,200	...	...	...	...	...	...	53
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	54
...	...	...	...	...	...	...	...	18	57,235	8	1,435	1	1,000	3	6,800	6	48,000	...	...	55
...	...	...	...	...	...	...	...	7	3,994	3	434	4	3,560	...	...	...	...	5	124	56
2	2,650	...	...	1	650	1	2,000	3	1,750	2	350	1	1,400	...	...	...	...	...	...	57

Table 65.—COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—GENERATING AND SUBSIDIARY EQUIPMENT, AND OUTPUT OF STATIONS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

DIVISION AND STATE.	Number of stations.	GENERATING EQUIPMENT—NUMBER AND KILOWATT CAPACITY OF DYNAMOS.								SUBSIDIARY EQUIPMENT.								Output of stations, kilowatt hours.
		Total.		Direct current, constant voltage.		Direct current, constant amperage.		Alternating and polyphase current.		Rotary converters and motor generator sets.		Boosters.		Transformers.		Auxiliary generators.		
		Number.	Kilowatts.	Number.	Kilowatts.	Number.	Kilowatts.	Number.	Kilowatts.	Number.	Kilowatts	Number.	Kilowatts.	Number.	Kilowatts.	Number.	Kilowatts.	
UNITED STATES	5,221	12,597	5,134,689	3,401	429,662	745	43,828	8,451	4,661,199	1,827	1,009,136	328	22,821	13,868	4,103,939	251	35,689	11,532,963,006
GEOGRAPHIC DIVISIONS:																		
New England	368	1,128	514,889	246	36,437	58	2,931	824	475,521	178	72,044	29	1,586	1,785	287,514	59	4,782	879,272,535
Middle Atlantic	669	2,459	1,378,811	673	142,421	269	16,338	1,517	1,220,052	700	453,955	37	3,324	2,832	1,032,083	41	4,029	3,548,605,305
East North Central	1,260	3,077	1,176,528	859	114,942	303	17,122	1,915	1,044,464	385	217,429	151	7,885	2,706	607,904	32	3,208	2,527,964,097
West North Central	1,077	1,973	404,172	773	52,398	30	1,770	1,170	350,004	148	72,416	41	1,282	1,552	275,567	27	1,985	712,595,442
South Atlantic	512	1,060	412,779	194	17,017	42	3,042	824	392,720	111	71,201	16	1,490	1,205	603,245	36	5,470	679,856,425
East South Central	330	612	150,042	150	15,736	19	1,445	443	132,861	63	14,204	2	27	227	41,835	5	326	227,664,808
West South Central	507	1,076	158,369	302	22,583	8	618	766	135,168	73	20,845	2	60	289	16,062	10	329	233,947,656
Mountain	250	592	261,119	112	8,457	10	412	470	252,250	44	11,073	12	233	1,047	333,678	10	2,385	845,393,882
Pacific	248	620	677,980	92	19,671	6	150	522	658,159	125	75,969	38	6,934	2,225	906,051	31	13,175	1,877,662,856
NEW ENGLAND:																		
Maine	79	187	58,757	36	3,296	13	467	138	54,994	7	2,300	3	66	431	48,873	25	715	117,092,565
New Hampshire	59	159	57,768	26	3,261	......	......	133	54,507	11	3,763	1	20	137	42,008	4	485	126,593,970
Vermont	61	116	29,468	7	143	2	40	107	29,285	2	350	......	......	167	17,381	1	300	56,552,977
Massachusetts	117	426	252,732	106	20,452	19	905	301	231,375	131	52,266	20	1,021	805	125,492	23	2,932	386,254,294
Rhode Island	8	55	38,509	8	2,250	22	1,409	25	34,850	9	7,100	2	240	96	18,896	......	......	62,106,528
Connecticut	44	185	77,655	63	7,035	2	110	120	70,510	18	6,265	3	239	149	34,864	6	350	130,672,201
MIDDLE ATLANTIC:																		
New York	321	1,084	772,030	285	63,999	77	5,025	722	703,006	426	332,613	26	2,628	1,799	718,691	27	2,719	2,175,048,634
New Jersey	64	382	179,477	118	32,012	51	3,416	213	144,049	83	53,329	6	550	213	76,403	......	......	383,891,504
Pennsylvania	284	993	427,304	270	46,410	141	7,897	582	372,997	191	68,013	5	146	820	236,989	14	1,310	989,665,167
EAST NORTH CENTRAL:																		
Ohio	304	756	244,182	247	45,906	75	3,544	434	194,732	45	26,605	4	467	401	85,239	4	405	399,101,309
Indiana	201	472	135,801	110	11,692	47	2,913	315	121,196	36	14,797	3	430	801	72,484	5	360	236,944,000
Illinois	269	813	449,917	183	25,624	122	8,083	508	416,210	158	103,870	5	203	565	148,293	6	1,375	1,150,900,306
Michigan	235	535	247,789	127	12,313	29	1,252	379	234,224	119	58,037	126	6,080	746	259,639	14	733	525,615,508
Wisconsin	251	501	98,839	192	19,407	30	1,330	279	78,102	27	14,120	13	705	193	42,249	3	335	215,402,974
WEST NORTH CENTRAL:																		
Minnesota	195	366	93,502	184	13,754	1	100	181	79,648	35	22,005	7	451	816	186,156	1	5	186,045,055
Iowa	223	447	53,237	198	13,423	8	188	241	39,626	6	1,705	8	108	109	13,917	6	309	67,166,647
Missouri	190	335	122,786	93	9,520	16	1,339	226	111,927	39	24,100	16	155	95	14,828	8	1,125	232,828,763
North Dakota	42	95	10,824	52	4,491	3	116	40	6,217	5	510	2	20	12	805	2	45	12,298,553
South Dakota	77	143	20,032	63	2,492	......	......	80	17,540	8	555	3	8	114	12,735	4	120	24,703,754
Nebraska	174	271	34,586	114	4,293	1	17	156	30,276	9	2,338	1	30	248	8,166	......	......	56,299,682
Kansas	176	316	69,205	69	4,425	1	10	246	64,770	46	21,203	4	510	158	38,960	6	381	133,252,988
SOUTH ATLANTIC:																		
Delaware	14	34	2,895	10	375	......	......	24	2,520	......	......	......	......	12	320	2	250	3,412,319
Maryland	41	142	43,034	30	1,786	19	1,891	93	39,357	28	26,400	4	415	136	32,477	2	100	23,629,117
Dist. of Columbia	1	26	41,208	9	3,000	10	608	7	37,600	38	29,300	6	550	46	19,452	3	300	40,953,449
Virginia	67	130	40,512	33	1,956	......	......	97	38,556	6	431	......	......	73	39,450	6	1,300	28,724,684
West Virginia	58	141	29,772	43	4,077	11	433	87	25,262	22	5,897	......	......	283	45,190	......	......	42,344,796
North Carolina	94	132	43,099	22	814	......	......	110	42,285	1	150	4	222	99	54,701	13	320	70,552,737
South Carolina	61	160	132,408	21	2,615	......	......	139	129,793	7	6,820	1	300	447	355,705	6	3,050	356,771,757
Georgia	126	195	56,232	14	1,546	1	35	180	54,651	5	1,000	1	3	92	54,390	......	......	87,571,815
Florida	50	100	23,619	12	848	1	75	87	22,696	4	1,203	......	......	17	1,560	4	150	25,895,751
EAST SOUTH CENTRAL:																		
Kentucky	89	186	54,062	53	6,174	13	970	120	46,918	23	7,675	......	......	70	11,997	2	140	75,593,179
Tennessee	90	159	49,640	42	2,993	2	120	115	46,527	15	2,397	......	......	89	19,344	1	100	75,544,893
Alabama	69	129	24,477	31	4,367	1	75	97	20,035	11	2,158	1	25	36	9,459	2	86	48,602,553
Mississippi	82	138	21,863	24	2,202	3	280	111	19,381	14	1,974	1	2	32	1,035	......	......	27,924,183
WEST SOUTH CENTRAL:																		
Arkansas	74	135	16,335	34	1,915	4	138	97	14,282	2	500	......	......	13	1,123	......	......	17,786,660
Louisiana	50	112	19,169	47	5,697	......	......	65	13,472	16	7,840	......	......	14	5,186	1	16	18,328,080
Oklahoma	130	243	38,301	27	4,130	......	......	216	34,171	13	2,595	2	60	76	4,715	7	283	48,824,097
Texas	253	586	84,564	194	10,841	4	480	388	73,243	42	9,910	......	......	186	5,038	2	30	149,008,819
MOUNTAIN:																		
Montana	29	105	74,398	17	1,585	1	50	87	72,763	4	2,090	......	......	155	91,377	......	......	379,212,617
Idaho	38	68	35,656	6	126	......	......	62	35,530	10	2,205	......	......	233	47,168	3	900	115,812,292
Wyoming	20	56	8,212	16	1,077	......	......	40	7,135	7	805	1	45	21	2,174	3	240	11,580,567
Colorado	73	163	71,668	38	3,279	3	112	122	68,277	13	3,573	5	50	329	104,579	......	......	165,196,068
New Mexico	21	50	7,981	6	801	2	75	42	7,105	2	350	6	138	3	30	1	38	9,027,824
Arizona	16	50	14,756	14	991	......	......	36	13,765	7	1,550	......	......	53	14,877	2	1,200	32,960,084
Utah	45	74	37,935	9	435	......	......	65	37,500	......	......	......	......	204	53,396	......	......	86,634,658
Nevada	8	26	10,513	6	163	4	175	16	10,175	1	500	......	......	49	20,077	1	7	44,969,772
PACIFIC:																		
Washington	70	112	57,283	17	1,658	......	......	95	55,625	4	1,260	8	120	110	31,528	6	375	71,414,473
Oregon	66	120	32,416	27	624	......	......	93	31,792	4	459	......	......	211	45,073	1	550	58,789,342
California	112	388	588,281	48	17,389	6	150	334	570,742	117	74,250	30	6,814	1,904	829,450	24	12,250	1,747,459,041

TABLE 66.—COMMERCIAL CENTRAL ELECTRIC STATIONS—GENERATING AND SUBSIDIARY EQUIPMENT, AND OUTPUT OF STATIONS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

DIVISION AND STATE.	Number of stations.	GENERATING EQUIPMENT—NUMBER AND KILOWATT CAPACITY OF DYNAMOS.								SUBSIDIARY EQUIPMENT.								Output of stations, kilowatt hours.
		Total.		Direct current, constant voltage.		Direct current, constant amperage.		Alternating and polyphase current.		Rotary converters and motor generator sets.		Boosters.		Transformers.		Auxiliary generators.		
		Number.	Kilowatts.	Number.	Kilowatts.	Number.	Kilo watts.	Number.	Kilowatts.	Number.	Kilowatts.	Number.	Kilowatts	Number.	Kilowatts.	Number.	Kilowatts	
UNITED STATES	3,659	9,837	4,766,012	2,821	398,046	518	30,880	6,498	4,337,086	1,781	996,531	295	20,151	12,972	4,039,236	217	33,114	10,995,436,276
GEOGRAPHIC DIVISIONS:																		
New England	311	1,007	482,629	234	34,927	54	2,766	719	444,936	174	71,809	26	1,557	1,687	281,311	58	4,752	840,036,140
Middle Atlantic	567	2,240	1,357,040	634	140,541	238	14,838	1,368	1,201,661	698	453,902	35	3,274	2,815	1,031,162	40	3,969	3,519,216,083
East North Central	786	2,132	1,057,393	671	103,670	152	7,624	1,309	946,099	365	208,167	151	7,885	2,333	576,366	18	1,690	2,280,324,043
West North Central	678	1,324	346,927	541	40,351	16	1,168	767	305,408	143	71,993	34	1,198	1,422	272,229	21	1,579	650,867,731
South Atlantic	308	753	367,716	161	15,753	31	2,589	561	349,374	105	70,027	15	1,400	1,131	594,695	31	5,070	630,531,082
East South Central	202	403	126,311	111	13,427	5	815	287	112,069	60	14,146	1	25	158	39,629	3	240	195,999,962
West South Central	385	865	137,455	273	21,426	7	568	585	115,461	70	20,505	2	60	219	12,845	10	329	211,050,496
Mountain	211	541	254,612	109	8,418	9	362	423	245,832	44	11,073	12	233	1,028	331,648	10	2,385	836,590,469
Pacific	211	572	635,929	87	19,533	6	150	479	616,246	122	74,909	19	4,519	2,179	899,351	26	13,100	1,830,820,270
NEW ENGLAND:																		
Maine	75	180	57,467	36	3,296	13	467	131	53,704	7	2,300	1	62	426	48,571	25	715	115,034,805
New Hampshire	56	155	57,098	26	3,261			129	53,837	11	3,763	1	20	136	41,933	4	485	126,129,170
Vermont	48	95	25,261	5	118	1	25	89	25,118	2	350			140	15,779	1	300	52,635,978
Massachusetts	87	362	233,228	104	19,852	18	849	240	212,527	129	52,081	19	996	746	121,326	22	2,902	358,563,754
Rhode Island	7	52	38,365	8	2,250	21	1,365	23	34,750	9	7,100	2	240	96	18,896			61,991,961
Connecticut	38	163	71,210	55	6,150	1	60	107	65,000	16	6,215	3	239	143	34,806	6	350	125,680,472
MIDDLE ATLANTIC:																		
New York	272	991	762,859	262	63,010	76	5,007	653	694,842	424	332,560	24	2,578	1,790	717,991	27	2,719	2,160,064,465
New Jersey	56	363	177,243	117	31,987	46	3,166	200	142,090	83	53,329	6	550	211	76,368			381,674,327
Pennsylvania	239	886	416,938	255	45,544	116	6,665	515	364,729	191	68,013	5	146	814	236,803	13	1,250	977,477,291
EAST NORTH CENTRAL:																		
Ohio	186	529	216,545	194	43,027	56	2,582	279	170,936	42	26,355	4	467	336	80,607	2	285	359,821,051
Indiana	130	332	112,030	76	9,337	34	2,187	222	100,506	32	14,585	3	430	715	70,656	5	360	205,722,726
Illinois	170	549	423,932	146	22,736	18	1,078	385	400,118	146	95,120	5	203	463	134,861	4	275	1,047,003,985
Michigan	127	339	215,701	89	10,551	16	567	234	204,583	118	57,987	126	6,080	646	248,693	4	435	461,111,350
Wisconsin	173	383	89,185	166	18,019	28	1,210	189	69,956	27	14,120	13	705	173	41,549	3	335	206,664,931
WEST NORTH CENTRAL:																		
Minnesota	91	193	79,613	84	8,676			109	70,937	34	21,905	3	406	799	185,523	1	5	170,985,436
Iowa	159	338	44,231	151	10,452	6	123	181	33,656	5	1,655	6	99	103	13,792	6	309	57,191,263
Missouri	125	224	110,907	73	8,100	8	1,019	143	101,788	38	23,900	16	155	60	13,785	7	1,000	219,381,412
North Dakota	33	76	9,144	45	4,026	1	16	30	5,102	5	510	2	20	12	805	2	45	10,766,533
South Dakota	64	119	18,356	52	2,076			67	16,280	7	520	3	8	114	12,735	4	120	23,537,072
Nebraska	112	183	26,747	82	3,050			101	23,697	8	2,300			229	7,716			47,765,962
Kansas	94	191	57,929	54	3,971	1	10	136	53,948	46	21,203	4	510	105	37,873	1	100	121,240,053
SOUTH ATLANTIC:																		
Delaware	8	18	1,995	2	115			16	1,880					11	305	2	250	2,255,400
Maryland	34	123	40,133	26	1,666	19	1,891	78	36,576	28	26,400	4	415	135	32,457	2	100	20,575,129
District of Columbia	1	26	41,208	9	3,000	10	608	7	37,600	38	29,300	6	550	46	19,452	3	300	40,953,449
Virginia	53	99	33,442	26	1,751			73	31,691	3	260			48	36,600	6	1,300	20,564,230
West Virginia	52	127	28,999	43	4,077	1	15	83	24,907	22	5,897			283	45,190			40,905,654
North Carolina	46	78	37,559	15	409			63	37,150	1	150	3	132	87	52,561	13	320	63,898,266
South Carolina	39	129	129,304	19	2,611			110	126,693	7	6,820	1	300	436	354,650	5	2,800	353,704,032
Georgia	42	88	44,424	14	1,546			74	42,878	5	1,000	1	3	77	53,220			75,270,055
Florida	33	65	10,652	7	578	1	75	57	9,999	1	200			8	260			12,404,867
EAST SOUTH CENTRAL:																		
Kentucky	73	155	49,199	48	5,774	3	540	104	42,885	23	7,675			70	11,997	2	140	65,882,463
Tennessee	60	102	42,528	26	2,023			76	40,505	15	2,397			34	17,780	1	100	65,773,123
Alabama	34	82	19,903	26	4,135	1	75	55	15,693	10	2,152	1	25	32	9,128			43,320,030
Mississippi	35	64	14,681	11	1,495	1	200	52	12,986	12	1,922			22	724			21,024,346
WEST SOUTH CENTRAL:																		
Arkansas	56	102	12,570	27	1,560	3	88	72	10,922	2	500			5	643			13,791,366
Louisiana	27	66	14,945	33	5,130			33	9,815	16	7,840			11	5,125	1	16	13,851,237
Oklahoma	67	142	30,336	20	3,995			122	26,341	12	2,495	2	60	25	2,167	7	283	42,590,541
Texas	235	555	79,604	193	10,741	4	480	358	68,383	40	9,670			178	4,910	2	30	140,817,352
MOUNTAIN:																		
Montana	27	100	73,778	17	1,585			83	72,193	4	2,090			155	91,377			377,172,532
Idaho	35	65	34,956	6	126			59	34,830	10	2,205			233	47,168	3	900	114,882,022
Wyoming	18	53	8,045	15	1,060			38	6,985	7	805	1	45	21	2,174	3	240	11,463,667
Colorado	62	146	69,716	36	3,257	3	112	107	66,347	13	3,573	5	50	322	103,554			163,855,226
New Mexico	18	44	7,496	6	801	2	75	36	6,620	2	350	6	138	3	30	1	38	8,513,344
Arizona	16	50	14,756	14	991			36	13,765	7	1,550			53	14,877	2	1,200	32,960,084
Utah	28	57	35,352	9	435			48	34,917					192	52,391			82,773,822
Nevada	7	26	10,513	6	163	4	175	16	10,175	1	500			49	20,077	1	7	44,969,772
PACIFIC:																		
Washington	60	98	24,223	17	1,658			81	22,565	1	200			104	30,828	1	300	37,107,773
Oregon	54	106	29,758	22	486			84	29,272	4	459			201	43,448	1	550	55,194,216
California	97	368	581,948	48	17,389	6	150	314	564,409	117	74,250	19	4,519	1,874	825,075	24	12,250	1,738,518,281

Table 67.—MUNICIPAL CENTRAL ELECTRIC STATIONS—GENERATING AND SUBSIDIARY EQUIPMENT, AND OUTPUT OF STATIONS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

DIVISION AND STATE.	Number of stations.	GENERATING EQUIPMENT—NUMBER AND KILOWATT CAPACITY OF DYNAMOS.								SUBSIDIARY EQUIPMENT.								Output of stations, kilowatt hours.
		Total.		Direct current, constant voltage.		Direct current, constant amperage.		Alternating and polyphase current.		Rotary converters and motor generator sets.		Boosters.		Transformers.		Auxiliary generators.		
		Number.	Kilowatts.	Numbet.	Kilowatts.	Number.	Kilowatts.	Number.	Kilowatts.	Number.	Kilowatts.	Number.	Kilowatts.	Number.	Kilowatts.	Number.	Kilowatts.	
UNITED STATES	1,562	2,760	368,677	580	31,616	227	12,948	1,953	324,113	46	12,605	33	2,670	896	64,703	34	2,575	537,526,730
GEOGRAPHIC DIVISIONS:																		
New England	57	121	32,260	12	1,510	4	165	105	30,585	4	235	3	29	98	6,203	1	30	39,236,395
Middle Atlantic	102	219	21,771	39	1,880	31	1,500	149	18,391	2	53	2	50	17	921	1	60	29,389,222
East North Central	474	945	119,135	188	11,272	151	9,498	606	98,365	20	9,262			373	31,538	14	1,518	247,640,054
West North Central	399	649	57,245	232	12,047	14	602	403	44,596	5	423	7	84	130	3,338	6	406	61,727,711
South Atlantic	204	307	45,063	33	1,264	11	453	263	43,346	6	1,174	1	90	74	8,550	5	400	49,325,343
East South Central	128	209	23,731	39	2,309	14	630	156	20,792	3	58	1	2	69	2,206	2	86	31,664,846
West South Central	122	211	20,914	29	1,157	1	50	181	19,707	3	340			70	3,217			22,897,160
Mountain	39	51	6,507	3	39	1	50	47	6,418					19	2,030			8,803,413
Pacific	37	48	42,051	5	138			43	41,913	3	1,060	19	2,415	46	6,700	5	75	46,842,586
NEW ENGLAND:																		
Maine	4	7	1,290					7	1,290			2	4	5	302			2,057,760
New Hampshire	3	4	670					4	670					1	75			464,800
Vermont	13	21	4,207	2	25	1	15	18	4,167					27	1,602			3,916,999
Massachusetts	30	64	19,504	2	600	1	56	61	18,848	2	185	1	25	59	4,166	1	30	27,690,540
Rhode Island	1	3	144			1	44	2	100									114,567
Connecticut	6	22	6,445	8	885	1	50	13	5,510	2	50			6	58			4,991,729
MIDDLE ATLANTIC:																		
New York	49	93	9,171	23	989	1	18	69	8,164	2	53	2	50	9	700			14,984,169
New Jersey	8	19	2,234	1	25	5	250	13	1,959					2	35			2,217,177
Pennsylvania	45	107	10,366	15	866	25	1,232	67	8,268					6	186	1	60	12,187,876
EAST NORTH CENTRAL:																		
Ohio	118	227	27,637	53	2,879	19	962	155	23,796	3	250			65	4,632	2	120	39,280,258
Indiana	71	140	23,771	34	2,355	13	726	93	20,690	4	212			86	1,828			31,221,274
Illinois	99	264	25,985	37	2,888	104	7,005	123	16,092	12	8,750			102	13,432	2	1,100	103,896,321
Michigan	108	196	32,088	38	1,762	13	685	145	29,641	1	50			100	10,946	10	298	64,504,158
Wisconsin	78	118	9,654	26	1,388	2	120	90	8,146					20	700			8,738,043
WEST NORTH CENTRAL:																		
Minnesota	104	173	13,889	100	5,078	1	100	72	8,711	1	100	4	45	17	633			15,059,619
Iowa	64	109	9,006	47	2,971	2	65	60	5,970	1	50	2	9	6	125			9,975,384
Missouri	65	111	11,879	20	1,420	8	320	83	10,139	1	200			35	1,043	1	125	13,447,351
North Dakota	9	19	1,680	7	465	2	100	10	1,115									1,532,020
South Dakota	13	24	1,676	11	416			13	1,260	1	35							1,166,682
Nebraska	62	88	7,839	32	1,243	1	17	55	6,579	1	38	1	30	19	450			8,533,720
Kansas	82	125	11,276	15	454			110	10,822					53	1,087	5	281	12,012,935
SOUTH ATLANTIC:																		
Delaware	6	16	900	8	260			8	640					1	15			1,156,919
Maryland	7	19	2,901	4	120			15	2,781					1	20			3,053,988
Virginia	14	31	7,070	7	205			24	6,865	3	171			25	2,850			8,160,454
West Virginia	6	14	773			10	418	4	355									1,439,142
North Carolina	48	54	5,540	7	405			47	5,135			1	90	12	2,140			6,654,471
South Carolina	22	31	3,104	2	4			29	3,100					11	1,055	1	250	3,067,725
Georgia	84	107	11,808			1	35	106	11,773					15	1,170			12,301,760
Florida	17	35	12,967	5	270			30	12,697	3	1,003			9	1,300	4	150	13,490,884
EAST SOUTH CENTRAL:																		
Kentucky	16	31	4,863	5	400	10	430	16	4,033									9,710,716
Tennessee	30	57	7,112	16	970	2	120	39	6,022					55	1,564			9,771,770
Alabama	35	47	4,574	5	232			42	4,342	1	6			4	331	2	86	5,282,523
Mississippi	47	74	7,182	13	707	2	80	59	6,395	2	52	1	2	10	311			6,899,837
WEST SOUTH CENTRAL:																		
Arkansas	18	33	3,765	7	355	1	50	25	3,360					8	480			3,995,294
Louisiana	23	46	4,224	14	567			32	3,657					3	61			4,476,843
Oklahoma	63	101	7,965	7	135			94	7,830	1	100			51	2,548			6,233,556
Texas	18	31	4,960	1	100			30	4,860	2	240			8	128			8,191,467
MOUNTAIN:																		
Montana	2	5	620			1	50	4	570									2,040,085
Idaho	3	3	700					3	700									930,270
Wyoming	2	3	167	1	17			2	150									116,900
Colorado	11	17	1,952	2	22			15	1,930					7	1,025			1,340,842
New Mexico	3	6	485					6	485									514,480
Utah	17	17	2,583					17	2,583					12	1,005			3,860,836
Nevada	1																	
PACIFIC:																		
Washington	10	14	33,060					14	33,060	3	1,060	8	120	6	700	5	75	34,306,700
Oregon	12	14	2,658	5	138			9	2,520					10	1,625			3,595,126
California	15	20	6,333					20	6,333			11	2,295	30	4,375			8,940,760

Table 68.—COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—LINE EQUIPMENT AND NUMBER OF CUSTOMERS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

DIVISION AND STATE.	Number of stations.	ESTIMATED NUMBER OF LAMPS WIRED FOR SERVICE.												STATIONARY MOTORS SERVED.		Number of meters on consumption circuits.	Number of customers.
		Total.			Street lighting.			Public buildings.			Commercial.						
		Arc.	Incandescent.	All other varieties.	Arc.	Incandescent.	All other varieties.	Arc.	Incandescent.	All other varieties.	Arc.	Incandescent.	All other varieties.	Number.	Horsepower.		
United States....	5,221	505,395	76,484,096	23,046	348,643	681,379	578	3,215	1,352,452	334	153,537	74,450,265	22,134	435,473	4,130,619	3,617,189	3,837,518
Geographic divisions:																	
New England........	368	44,682	7,955,766	2,147	29,633	124,142	290	26	218,171	50	15,023	7,613,453	1,807	55,042	391,308	312,278	313,227
Middle Atlantic......	669	181,582	22,096,036	7,883	109,039	125,044	89	505	429,890	......	72,038	21,541,102	7,794	124,416	1,213,681	842,450	822,906
East North Central..	1,260	138,042	18,590,902	9,170	106,688	114,419	......	845	238,186	233	30,509	18,238,297	8,937	114,404	799,421	940,883	972,903
West North Central..	1,077	40,860	8,327,120	807	24,751	102,152	139	98	133,748	14	16,011	8,091,220	654	47,540	316,113	451,386	505,019
South Atlantic.......	512	21,389	3,886,979	463	17,679	44,142	60	1,515	143,372	11	2,195	3,699,465	392	26,163	361,011	167,314	193,909
East South Central..	330	18,365	2,147,154	307	15,247	18,816	......	49	38,715	......	3,069	2,089,623	307	7,592	62,081	107,106	132,433
West South Central..	507	19,645	3,285,680	751	14,326	27,083	......	63	44,414	26	5,256	3,214,183	725	15,337	103,765	192,764	223,283
Mountain............	250	9,926	2,239,281	56	8,150	23,317	......	17	28,486	......	1,759	2,187,478	56	12,114	235,506	152,738	182,108
Pacific...............	248	30,904	7,955,178	1,462	23,130	102,264	......	97	77,470	......	7,677	7,775,444	1,462	32,865	647,733	450,270	491,730
New England:																	
Maine...............	79	1,863	481,656	92	1,411	9,839	......	......	14,656	......	452	457,161	92	2,258	32,535	25,062	28,511
New Hampshire.....	59	1,900	397,487	4	1,482	9,100	......	5	9,680	......	413	378,707	4	1,958	18,488	21,241	22,752
Vermont.............	61	1,080	404,049	102	1,013	5,563	......	3	6,325	50	64	392,161	52	1,966	23,695	18,880	22,380
Massachusetts.......	117	28,238	4,686,834	412	17,601	67,372	......	15	133,974	......	10,622	4,485,488	412	37,191	228,868	170,310	163,993
Rhode Island........	8	4,419	640,769	......	3,058	10,640	......	......	29,291	......	1,361	600,838	......	3,690	28,186	24,276	19,088
Connecticut..........	44	7,182	1,344,971	1,537	5,068	21,628	290	3	24,245	......	2,111	1,299,098	1,247	7,979	59,536	52,509	56,503
Middle Atlantic:																	
New York...........	321	94,324	12,884,436	475	47,391	62,706	......	213	283,019	......	46,720	12,538,711	475	82,525	795,256	461,591	434,110
New Jersey..........	64	22,585	2,961,254	89	16,052	33,708	89	228	87,905	......	6,305	2,839,641	......	12,772	85,011	108,579	105,785
Pennsylvania........	284	64,673	6,250,346	7,319	45,596	28,630	......	64	58,966	......	19,013	6,162,750	7,319	29,119	333,414	272,280	283,011
East North Central:																	
Ohio.................	304	36,318	3,454,142	373	30,893	20,168	......	116	25,957	......	5,309	3,408,017	373	29,022	145,331	170,756	174,467
Indiana..............	201	17,328	2,375,533	147	14,989	19,873	......	187	26,092	......	2,152	2,329,568	147	14,005	91,897	146,185	156,603
Illinois...............	269	53,486	7,375,038	501	35,399	41,065	......	379	84,786	......	17,708	7,249,187	501	46,278	315,659	356,074	364,046
Michigan.............	235	20,516	3,601,427	1,179	16,220	22,425	......	155	75,293	233	4,141	3,503,709	946	18,400	174,009	181,872	187,545
Wisconsin............	251	10,394	1,784,762	6,970	9,187	10,888	......	8	26,058	......	1,199	1,747,816	6,970	6,699	72,525	85,996	90,242
West North Central:																	
Minnesota...........	195	9,201	1,857,876	430	6,495	21,776	1	21	28,054	......	2,685	1,808,046	429	12,203	75,973	98,660	104,504
Iowa.................	223	4,679	1,512,552	16	3,637	27,479	......	15	35,535	......	1,027	1,449,538	16	8,773	43,820	83,294	90,299
Missouri.............	190	13,394	2,526,515	......	6,687	16,719	......	17	24,920	......	6,690	2,484,876	......	15,429	116,971	120,689	143,997
North Dakota........	42	866	219,451	1	644	5,074	......	7	3,319	......	215	211,058	1	1,145	6,128	14,489	15,618
South Dakota........	77	1,134	278,042	179	904	4,382	......	16	5,444	8	214	268,216	171	1,394	13,619	18,644	20,391
Nebraska............	174	3,682	1,034,661	......	2,451	12,149	......	2	21,351	......	1,229	1,001,161	......	3,575	26,325	57,995	61,814
Kansas...............	176	7,904	898,023	181	3,933	14,573	138	20	15,125	6	3,951	868,325	37	5,021	33,277	57,615	68,396
South Atlantic:																	
Delaware............	14	131	41,959	......	91	1,507	......	40	920	......	......	39,532	......	74	443	2,337	3,445
Maryland............	41	6,047	1,025,961	22	4,147	9,276	......	1,455	51,278	......	445	965,407	22	10,884	59,848	40,097	42,618
Dist. of Columbia...	1	1,966	658,899	265	1,166	5,626	60	......	46,519	......	800	606,754	205	2,760	16,236	19,796	20,402
Virginia..............	67	2,589	237,079	......	2,513	4,369	......	......	4,001	......	76	228,709	......	753	8,570	10,642	14,948
West Virginia........	58	2,468	305,312	......	2,096	2,922	......	4	3,657	......	368	298,733	......	1,279	22,925	14,833	18,165
North Carolina......	94	1,928	571,380	4	1,887	5,532	......	2	4,180	......	39	561,668	4	1,876	32,830	20,800	25,676
South Carolina......	61	2,345	268,720	1	2,196	2,875	......	......	5,391	......	149	260,454	1	5,452	155,385	16,765	17,602
Georgia..............	126	2,651	410,068	......	2,370	7,283	......	7	15,475	......	274	387,310	......	1,964	50,633	21,109	29,109
Florida...............	50	1,264	367,601	171	1,213	4,752	......	7	11,951	11	44	350,898	160	1,121	14,141	20,935	21,944
East South Central:																	
Kentucky............	89	7,814	849,194	26	7,332	5,278	......	14	11,889	......	468	832,027	26	4,106	22,621	41,200	51,204
Tennessee...........	90	4,808	670,870	280	3,938	6,732	......	14	12,560	......	856	651,578	280	1,720	20,357	29,678	35,326
Alabama.............	69	3,920	347,871	......	2,314	2,805	......	5	6,935	......	1,601	338,131	......	1,065	11,148	17,870	23,890
Mississippi..........	82	1,823	279,219	1	1,663	4,001	......	16	7,331	......	144	267,887	1	701	7,955	18,358	22,013
West South Central:																	
Arkansas............	74	1,102	243,725	3	1,045	4,731	......	......	3,168	......	57	235,826	3	994	5,283	15,035	20,500
Louisiana............	50	7,267	584,015	......	4,474	4,451	......	49	19,722	......	2,744	559,842	......	2,428	24,557	26,538	27,838
Oklahoma............	130	3,659	592,311	4	3,303	8,334	......	......	6,496	......	356	577,481	4	3,470	23,056	37,860	46,860
Texas................	253	7,617	1,865,629	744	5,504	9,567	......	14	15,028	26	2,099	1,841,034	718	8,445	50,869	113,331	128,085
Mountain:																	
Montana.............	29	2,193	388,718	......	1,560	2,791	......	......	1,297	......	633	384,630	......	1,962	75,184	30,543	32,312
Idaho................	38	1,349	261,092	4	1,109	3,886	......	5	1,800	......	235	255,406	4	1,723	27,142	17,694	26,078
Wyoming.............	20	492	112,226	2	396	1,168	......	......	3,229	......	96	107,829	2	672	6,224	6,729	8,437
Colorado.............	73	4,175	1,032,845	20	3,859	7,872	......	9	13,158	......	307	1,011,815	20	4,780	60,451	66,359	68,046
New Mexico.........	21	377	112,187	20	247	627	......	......	3,381	......	130	108,179	20	639	4,084	7,129	8,551
Arizona..............	16	686	136,390	10	454	1,335	......	3	1,642	......	229	133,413	10	741	12,547	10,256	12,668
Utah.................	45	333	150,380	......	321	5,237	......	......	3,481	......	12	141,662	......	1,044	37,490	9,329	19,887
Nevada..............	8	321	45,443	......	204	401	......	......	498	......	117	44,544	......	553	12,384	4,699	6,129
Pacific:																	
Washington..........	70	4,729	779,787	1,457	2,661	20,223	......	66	14,808	......	2,002	744,756	1,457	2,279	28,148	66,106	73,421
Oregon..............	66	1,285	382,196	......	1,128	6,239	......	8	2,631	......	149	373,326	......	1,527	15,843	24,290	33,627
California............	112	24,890	6,793,195	5	19,341	75,802	......	23	60,031	......	5,526	6,657,362	5	29,059	603,742	359,874	384,682

TABLE 69.—COMMERCIAL CENTRAL ELECTRIC STATIONS—LINE EQUIPMENT AND NUMBER OF CUSTOMERS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

DIVISION AND STATE.	Number of stations.	ESTIMATED NUMBER OF LAMPS WIRED FOR SERVICE.												STATIONARY MOTORS SERVED.		Number of meters on consumption circuits.	Number of customers.
		Total.			Street lighting.			Public buildings.			Commercial.						
		Arc.	Incandescent.	All other varieties.	Arc.	Incandescent.	All other varieties.	Arc.	Incandescent.	All other varieties.	Arc.	Incandescent.	All other varieties.	Number.	Horsepower.		
UNITED STATES...	3,659	413,544	69,428,356	20,937	264,152	474,048	440	2,961	1,128,807	51	146,431	67,825,501	20,446	413,578	3,966,328	3,146,998	3,311,870
GEOGRAPHIC DIVISIONS:																	
New England........	311	41,287	7,331,220	2,026	26,798	96,665	290	22	200,189	......	14,467	7,034,366	1,736	52,346	370,050	282,463	283,006
Middle Atlantic......	567	173,273	21,668,324	7,883	100,889	116,765	89	471	412,574	......	71,913	21,138,985	7,794	123,501	1,207,890	818,007	794,908
East North Central..	786	88,397	16,402,124	8,936	57,954	55,216	......	743	154,847	......	29,700	16,192,061	8,936	106,813	744,235	795,681	812,351
West North Central..	678	30,885	6,891,187	664	18,073	59,734	1	67	91,527	14	12,745	6,739,926	649	43,141	292,956	352,948	396,110
South Atlantic......	308	13,197	3,033,296	309	9,812	27,579	60	1,502	117,294	11	1,883	2,888,423	238	24,053	337,465	117,369	136,268
East South Central..	202	13,798	1,798,309	307	10,766	9,755	......	42	26,070	......	2,990	1,762,484	307	7,019	57,395	83,709	101,371
West South Central..	385	16,314	2,981,142	751	11,078	18,445	......	61	38,849	26	5,175	2,923,848	725	14,443	97,828	168,940	193,560
Mountain............	211	9,637	2,119,255	56	7,879	17,532	......	17	25,707	......	1,741	2,076,016	56	11,645	232,428	144,075	169,265
Pacific................	211	26,756	7,203,499	5	20,903	72,357	......	36	61,750	......	5,817	7,069,392	5	30,617	626,081	383,806	425,031
NEW ENGLAND:																	
Maine..................	75	1,546	461,237	92	1,094	7,790	......	......	10,715	......	452	442,732	92	2,240	32,408	24,608	27,873
New Hampshire.....	56	1,900	383,719	......	1,482	8,584	......	5	9,486	......	413	365,649	......	1,955	18,334	20,545	22,023
Vermont.............	48	769	338,772	2	709	3,787	......	3	5,666	......	57	329,319	2	1,812	21,484	15,226	17,518
Massachusetts.......	87	25,992	4,246,296	395	15,834	53,124	......	11	122,256	......	10,147	4,070,916	395	35,118	213,512	150,020	144,708
Rhode Island........	7	4,354	637,760	......	2,993	10,631	......	......	29,291	......	1,361	597,838	......	3,686	28,184	24,090	18,902
Connecticut..........	38	6,726	1,263,436	1,537	4,686	12,749	290	3	22,775	......	2,037	1,227,912	1,247	7,535	56,128	47,974	51,982
MIDDLE ATLANTIC:																	
New York...........	272	91,232	12,670,024	475	44,403	58,793	......	203	277,854	......	46,626	12,333,377	475	82,201	792,909	450,090	420,433
New Jersey..........	56	22,094	2,913,857	89	15,561	32,298	89	228	86,205	......	6,305	2,795,354	......	12,647	84,471	106,583	103,711
Pennsylvania........	239	59,947	6,084,443	7,319	40,925	25,674	......	40	48,515	......	18,982	6,010,254	7,319	28,653	330,510	261,334	270,764
EAST NORTH CENTRAL:																	
Ohio...................	186	26,430	2,860,529	373	21,234	6,888	......	113	13,412	......	5,083	2,840,229	373	27,569	135,580	136,643	137,304
Indiana................	130	12,171	1,895,115	147	10,077	9,550	......	177	18,511	......	1,917	1,867,054	147	12,052	78,613	105,414	114,257
Illinois................	170	31,652	7,100,992	500	13,586	20,835	......	370	68,469	......	17,696	7,011,688	500	44,225	296,458	338,433	341,415
Michigan.............	127	9,241	2,991,025	946	5,310	11,688	......	76	32,295	......	3,855	2,947,042	946	16,995	164,150	143,909	146,497
Wisconsin............	173	8,903	1,554,463	6,970	7,747	6,255	......	7	22,160	......	1,149	1,526,048	6,970	5,972	69,434	71,282	72,878
WEST NORTH CENTRAL:																	
Minnesota...........	91	7,841	1,453,474	429	5,239	13,584	1	6	19,099	......	2,596	1,420,791	428	10,824	69,916	70,404	74,373
Iowa..................	159	4,079	1,264,497	16	3,066	17,784	......	14	23,507	......	999	1,223,206	16	7,861	39,219	65,640	71,365
Missouri..............	125	11,425	2,249,490	......	4,785	8,603	......	15	15,347	......	6,625	2,225,540	......	14,871	113,182	104,050	124,136
North Dakota.......	33	585	188,882	1	385	3,320	......	4	2,867	......	196	182,695	1	1,091	5,345	12,263	13,097
South Dakota.......	64	857	238,870	175	627	3,246	......	16	4,183	8	214	231,441	167	1,271	12,971	15,912	17,263
Nebraska............	112	3,136	824,362	......	1,910	5,883	......	2	17,083	......	1,224	801,396	......	3,006	23,532	42,974	45,767
Kansas................	94	2,962	671,612	43	2,061	7,314	......	10	9,441	6	891	654,857	37	4,217	28,791	41,705	50,109
SOUTH ATLANTIC:																	
Delaware	8	126	20,578	......	86	850	......	40	50	......	......	19,678	......	57	394	1,494	2,048
Maryland	34	5,186	1,006,449	22	3,474	7,508	......	1,450	51,207	......	262	947,734	22	10,741	58,492	38,287	40,645
District of Columbia.	1	1,966	658,899	265	1,166	5,626	60	......	46,519	......	800	606,754	205	2,760	16,236	19,796	20,402
Virginia..............	53	684	153,826	......	652	2,098	......	......	1,177	......	32	150,551	......	524	5,461	7,201	10,592
West Virginia.......	52	1,681	300,435	......	1,313	2,826	......	......	3,656	......	368	293,953	......	1,279	22,925	14,696	17,589
North Carolina......	46	842	379,626	......	835	2,045	......	......	1,170	......	7	376,411	......	1,213	26,613	8,735	10,728
South Carolina......	39	1,534	188,950	1	1,399	1,380	......	......	4,896	......	135	182,674	1	5,227	153,655	12,034	12,596
Georgia...............	42	910	175,928	......	660	1,848	......	5	4,624	......	245	169,456	......	1,640	46,940	5,708	10,550
Florida................	33	268	148,605	21	227	3,398	......	7	3,995	11	34	141,212	10	612	6,749	9,418	11,118
EAST SOUTH CENTRAL:																	
Kentucky............	73	6,692	772,375	26	6,263	3,896	......	12	10,207	......	417	758,272	26	3,986	21,709	35,468	44,903
Tennessee...........	60	2,747	596,461	280	1,888	3,172	......	13	7,740	......	846	585,549	280	1,535	18,634	24,696	28,059
Alabama.............	34	3,253	265,994	......	1,652	1,135	......	2	4,017	......	1,599	260,842	......	944	10,196	12,974	16,328
Mississippi..........	35	1,106	163,479	1	963	1,552	......	15	4,106	......	128	157,821	1	554	6,856	10,571	12,081
WEST SOUTH CENTRAL:																	
Arkansas.............	56	418	175,705	3	373	2,837	......	......	2,393	......	45	170,475	3	871	4,551	11,226	15,473
Louisiana............	27	6,930	519,073	......	4,156	2,592	......	47	18,652	......	2,727	497,829	......	2,282	24,064	22,092	22,625
Oklahoma............	67	2,998	503,673	4	2,642	4,699	......	......	4,732	......	356	494,242	4	3,134	20,009	30,316	36,368
Texas.................	235	5,968	1,782,691	744	3,907	8,317	......	14	13,072	26	2,047	1,761,302	718	8,156	49,204	105,306	119,094
MOUNTAIN:																	
Montana.............	27	2,171	373,687	......	1,547	2,040	......	......	1,082	......	624	370,565	......	1,852	74,544	29,465	31,182
Idaho..................	35	1,260	241,131	4	1,024	2,535	......	5	1,042	......	231	237,554	4	1,686	26,655	16,584	24,645
Wyoming.............	18	472	110,433	2	376	1,059	......	......	3,229	......	96	106,145	2	666	6,174	6,669	8,237
Colorado.............	62	4,099	996,850	20	3,783	7,073	......	9	12,199	......	307	977,578	20	4,695	59,790	63,610	65,137
New Mexico..........	18	359	106,543	20	229	533	......	......	3,310	......	130	102,700	20	613	3,894	6,791	8,051
Arizona...............	16	686	136,390	10	454	1,335	......	3	1,642	......	229	133,413	10	741	12,547	10,256	12,668
Utah..................	28	269	110,278	......	262	2,706	......	......	2,720	......	7	104,852	......	848	36,483	6,211	13,436
Nevada...............	7	321	43,943	......	204	251	......	......	483	......	117	43,209	......	544	12,341	4,489	5,909
PACIFIC:																	
Washington..........	60	1,172	312,995	......	1,016	4,986	......	7	1,183	......	149	306,826	......	1,214	15,602	20,936	29,287
Oregon................	54	1,221	350,709	......	1,068	4,721	......	6	2,296	......	147	343,692	......	1,380	14,434	21,815	30,104
California............	97	24,363	6,539,795	5	18,819	62,650	......	23	58,271	......	5,521	6,418,874	5	28,023	596,045	341,055	365,640

TABLE 70.—MUNICIPAL CENTRAL ELECTRIC STATIONS—LINE EQUIPMENT AND NUMBER OF CUSTOMERS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

DIVISION AND STATE.	Number of stations.	ESTIMATED NUMBER OF LAMPS WIRED FOR SERVICE.												STATIONARY MOTORS SERVED.		Number of meters on consumption circuits.	Number of customers.
		Total.			Street lighting.			Public buildings.			Commercial.			Number.	Horsepower.		
		Arc.	Incandescent.	All other varieties.	Arc.	Incandescent.	All other varieties.	Arc.	Incandescent.	All other varieties.	Arc.	Incandescent.	All other varieties.				
UNITED STATES	1,562	91,851	7,055,740	2,109	84,491	207,331	138	254	223,645	283	7,106	6,624,764	1,688	21,895	164,291	470,191	525,648
GEOGRAPHIC DIVISIONS:																	
New England	57	3,395	624,546	121	2,835	27,477	......	4	17,982	50	556	579,087	71	2,696	21,258	29,815	30,221
Middle Atlantic	102	8,309	427,712	......	8,150	8,279	......	34	17,316	......	125	402,117	......	915	5,791	24,443	27,998
East North Central	474	49,645	2,188,778	234	48,734	59,203	......	102	83,339	233	809	2,046,236	1	7,591	55,186	145,202	160,552
West North Central	399	9,975	1,435,933	143	6,678	42,418	138	31	42,221	......	3,266	1,351,294	5	4,399	23,157	98,438	108,909
South Atlantic	204	8,192	853,683	154	7,867	16,563	......	13	26,078	......	312	811,042	154	2,110	23,546	49,945	57,641
East South Central	128	4,567	348,845	......	4,481	9,061	......	7	12,645	......	79	327,139	......	573	4,686	23,397	31,062
West South Central	122	3,331	304,538	......	3,248	8,638	......	2	5,565	......	81	290,335	......	894	5,937	23,824	29,723
Mountain	39	289	120,026	......	271	5,785	......	......	2,779	......	18	111,462	......	469	3,078	8,663	12,843
Pacific	37	4,148	751,679	1,457	2,227	29,907	......	61	15,720	......	1,860	706,052	1,457	2,248	21,652	66,464	66,699
NEW ENGLAND:																	
Maine	4	317	20,419	......	317	2,049	......	......	3,941	......	......	14,429	......	18	127	454	638
New Hampshire	3	......	13,768	4	......	516	......	......	194	......	......	13,058	4	3	154	696	729
Vermont	13	311	65,277	100	304	1,776	......	......	659	50	7	62,842	50	154	2,211	3,654	4,862
Massachusetts	30	2,246	440,538	17	1,767	14,248	......	4	11,718	......	475	414,572	17	2,073	15,356	20,290	19,285
Rhode Island	1	65	3,009	......	65	9	......	......	......	......	......	3,000	......	4	2	186	186
Connecticut	6	456	81,535	......	382	8,879	......	......	1,470	......	74	71,186	......	444	3,408	4,535	4,521
MIDDLE ATLANTIC:																	
New York	49	3,092	214,412	......	2,988	3,913	......	10	5,165	......	94	205,334	......	324	2,347	11,501	13,677
New Jersey	8	491	47,397	......	491	1,410	......	......	1,700	......	......	44,287	......	125	540	1,996	2,074
Pennsylvania	45	4,726	165,903	......	4,671	2,956	......	24	10,451	......	31	152,496	......	466	2,904	10,946	12,247
EAST NORTH CENTRAL:																	
Ohio	118	9,888	593,613	......	9,659	13,280	......	3	12,545	......	226	567,788	......	1,453	9,751	34,113	37,163
Indiana	71	5,157	480,418	......	4,912	10,323	......	10	7,581	......	235	462,514	......	1,953	13,284	40,771	42,346
Illinois	99	21,834	274,046	1	21,813	20,230	......	9	16,317	......	12	237,499	1	2,053	19,201	17,641	22,631
Michigan	108	11,275	610,402	233	10,910	10,737	......	79	42,998	233	286	556,667	......	1,405	9,859	37,963	41,048
Wisconsin	78	1,491	230,299	......	1,440	4,633	......	1	3,898	......	50	221,768	......	727	3,091	14,714	17,364
WEST NORTH CENTRAL:																	
Minnesota	104	1,360	404,402	1	1,256	8,192	......	15	8,955	......	89	387,255	1	1,379	6,057	28,256	30,131
Iowa	64	600	248,055	......	571	9,695	......	1	12,028	......	28	226,332	......	912	4,601	17,654	18,934
Missouri	65	1,969	277,025	......	1,902	8,116	......	2	9,573	......	65	259,336	......	558	3,789	16,639	19,861
North Dakota	9	281	30,569	......	259	1,754	......	3	452	......	19	28,363	......	54	783	2,226	2,521
South Dakota	13	277	39,172	4	277	1,136	......	......	1,261	......	......	36,775	4	123	648	2,732	3,128
Nebraska	62	546	210,299	......	541	6,266	......	......	4,268	......	5	199,765	......	569	2,793	15,021	16,047
Kansas	82	4,942	226,411	138	1,872	7,259	138	10	5,684	......	3,060	213,468	......	804	4,486	15,910	18,287
SOUTH ATLANTIC:																	
Delaware	6	5	21,381	......	5	657	......	......	870	......	......	19,854	......	17	49	843	1,397
Maryland	7	861	19,512	......	673	1,768	......	5	71	......	183	17,673	......	143	1,356	1,810	1,973
Virginia	14	1,905	83,253	......	1,861	2,271	......	......	2,824	......	44	78,158	......	229	3,109	3,441	4,356
West Virginia	6	787	4,877	......	783	96	......	4	1	......	......	4,780	......	......	......	137	576
North Carolina	48	1,086	191,754	4	1,052	3,487	......	2	3,010	......	32	185,257	4	663	6,217	12,065	14,948
South Carolina	22	811	79,770	......	797	1,495	......	......	495	......	14	77,780	......	225	1,730	4,731	5,006
Georgia	84	1,741	234,140	......	1,710	5,435	......	2	10,851	......	29	217,854	......	324	3,693	15,401	18,559
Florida	17	996	218,996	150	986	1,354	......	......	7,956	......	10	209,686	150	509	7,392	11,517	10,826
EAST SOUTH CENTRAL:																	
Kentucky	16	1,122	76,819	......	1,069	1,382	......	2	1,682	......	51	73,755	......	120	912	5,732	6,301
Tennessee	30	2,061	74,409	......	2,050	3,560	......	1	4,820	......	10	66,029	......	185	1,723	4,982	7,267
Alabama	35	667	81,877	......	662	1,670	......	3	2,918	......	2	77,289	......	121	952	4,896	7,562
Mississippi	47	717	115,740	......	700	2,449	......	1	3,225	......	16	110,066	......	147	1,099	7,787	9,932
WEST SOUTH CENTRAL:																	
Arkansas	18	684	68,020	......	672	1,894	......	......	775	......	12	65,351	......	123	732	3,809	5,027
Louisiana	23	337	64,942	......	318	1,859	......	2	1,070	......	17	62,013	......	146	493	4,446	5,213
Oklahoma	63	661	88,638	......	661	3,635	......	......	1,764	......	......	83,239	......	336	3,047	7,544	10,492
Texas	18	1,649	82,938	......	1,597	1,250	......	......	1,956	......	52	79,732	......	289	1,665	8,025	8,991
MOUNTAIN:																	
Montana	2	22	15,031	......	13	751	......	......	215	......	9	14,065	......	110	640	1,078	1,130
Idaho	3	89	19,961	......	85	1,351	......	......	758	......	4	17,852	......	37	487	1,110	1,433
Wyoming	2	20	1,793	......	20	109	......	......	......	......	......	1,684	......	6	50	60	200
Colorado	11	76	35,995	......	76	799	......	......	959	......	......	34,237	......	85	661	2,749	2,909
New Mexico	3	18	5,644	......	18	94	......	......	71	......	......	5,479	......	26	190	338	500
Utah	17	64	40,102	......	59	2,531	......	......	761	......	5	36,810	......	196	1,007	3,118	6,451
Nevada	1	......	1,500	......	......	150	......	......	15	......	......	1,335	......	9	43	210	220
PACIFIC:																	
Washington	10	3,557	466,792	1,457	1,645	15,237	......	59	13,625	......	1,853	437,930	1,457	1,065	12,546	45,170	44,134
Oregon	12	64	31,487	......	60	1,518	......	2	335	......	2	29,634	......	147	1,409	2,475	3,523
California	15	527	253,400	......	522	13,152	......	......	1,760	......	5	238,488	......	1,036	7,697	18,819	19,042

CENTRAL ELECTRIC LIGHT AND POWER STATIONS.

PART II.—TECHNICAL.

By THOMAS COMMERFORD MARTIN, *Expert Special Agent.*

TECHNICAL ASPECTS OF THE PERIOD.

GENERAL CONDITIONS.

The first Census Office report on central electric light and power stations for 1902 contained a historical review of their development and of the apparatus which had been employed up to that time or was then in use. The descriptions then given included some of the earlier stations, as well as dynamos, engines, motors, transformers, arc and incandescent lamps, meters, and other appliances. The next report (that of 1907) embraced data of the same general character, and the present report may therefore be considered as a continuation in its discussion of the evolution that has taken place since 1907.

The general statistics that have been presented in the preceding chapters of this report contain in themselves evidence of the changes which have taken place, and the remarks which will now be made on the technique of the industry will only serve to illustrate even more strikingly the incessant advances that characterize the electric art so preeminently. It stands to reason that an industry which has doubled itself in the two five-year periods within the time covered by the work of the Bureau of the Census is far from having reached a position of equilibrium, while there are no indications that this rate of increase has any tendency to fall off. Electric lighting is still the one great field in which electrical energy generated by central stations is employed, but more particularly within the last five years the application of the electric motor has been broadened and universalized, while a number of kindred arts, all based upon the consumption of electricity, have grown apace, increasing enormously the percentage of the miscellaneous sources from which central station income is derived. Detailed reference to these aspects of the industry will be made later. The interesting fact develops in connection with this greater increase of electric service to the public, that its cost has steadily decreased during the census periods referred to, while the cost of living has steadily increased. A typical example may be cited from the statistics of Massachusetts between 1904 and 1912, based upon the reports of the State Board of Gas and Electric Light Commissioners, which show that while in the seven years the cost of living predicated upon current market prices had risen 37 per cent, the rates for electricity had been reduced about 17 per cent. In other words, while the cost of food, coal, shoes, household equipment, etc., had increased over one-third in the seven years, the cost to the public of a very large proportion of its light and power furnished by public utilities had been lowered one-sixth.

Three remarkable developments are associated with the period 1907–1912, as contrasted with those of antecedent date, although the results are probably only a continued exemplification of the trend of the art and the irresistible push of the forces that have made it what it is as a centralized source of supply.

Consolidation of central stations.—One of these conditions of development has been the marked tendency toward central station consolidation. The process was never more active than during the period 1907–1912, taking on chiefly two aspects. In the earlier days of the industry it was only natural that a company operating within a small area in a given city or district should reach out with its circuits and cover additional territory or should merge in some way with other competitive companies covering the same region or municipality, in order to secure the economies and efficiencies which come from the operation of a large plant as compared with that of a small one. Hence there are very few cities or towns in the United States to-day where competitive central stations exist, the vast majority of them being under unified control but subject to the regulation of public-service commissions as to their rates, capital, conditions of service, and other features of the work. Some of these city systems have expanded so as to embrace large contiguous areas far beyond the original city limits. In the case of the Boston Edison Co., which supplied electricity originally to only one-eighth of a square mile, the area embraced by the circuits of the same company is now 700 square miles. The same principle has been given another application in the bringing together under one management of a large number of extraurban central station properties whose areas of service march together.

The Public Service Co. of New Jersey furnished electricity, gas, or electric street railway service, in 1912, to 202 municipalities in the state with a total population of 2,028,947, of which 173 communities with a population of 1,947,199 were supplied with electricity for light, heat, power, etc. It is unquestionably true that in all these places the quality, price, and continuity of the service were superior to what could be obtained through a number of small and often struggling local enterprises.

Equally notable in respect to extent and comprehension of system is the Pacific Gas & Electric Co. of California, which in 1912 was the owner or operator of plants and properties in 30 counties in central California, furnishing electric light and power to 187 communities, besides supplying gas, water, and street railway service in many of these or other places. The area covered was approximately 37,700 square miles, with a population in 1910 of 1,325,000, or about 55 per cent of that of the entire state. The electric generating capacity at the census of 1912 was 192,573 horsepower, of which 92,973 horsepower was hydroelectric, and the water-power capacity was being increased by a 53,300 horsepower plant then under construction. The total earnings of the company in 1911 were $14,500,000. In 1910 it had already 1,408 miles of high-tension transmission line, 950 miles of distributing transmission line, and 167 miles of underground cable in the central district of San Francisco.

The state of Illinois affords another example of what has been done in this respect. The Central Illinois Public Service Co. at the end of 1912 was serving 87 communities which were originally supplied by no fewer than 49 separate generating plants under nearly as many distinct managements.[1] This number had rapidly been reduced by consolidation to eight, which in turn were to be reduced to four, capable of generating all the needed energy. The advantages of such interconnected operation are best illustrated by the example of the Lake County district, Illinois, where this unified service effected a decrease in production costs from 7.08 cents per kilowatt hour to 2.87 cents per kilowatt hour, a saving of 4.21 cents per unit. The average price of electrical energy to the consumer was reduced by this process from 9.4 cents to 7.7 cents per kilowatt hour. The consumption per capita increased also from 40 kilowatt hours to 85. These figures and others were presented by President Samuel Insull, of the Commonwealth Edison Co., before the Franklin Institute in March, 1913, at which time he also called attention to the economies effected by the use of electricity in the operation of coal mines and in the farming districts in the state of Illinois. There were also other economies of a striking nature. A survey of central station plants in smaller Illinois towns showed that the plant-equipment reserves ranged from 15 to 82 per cent, yet the reliability of such service was always questionable. Although the maximum demands of various uses described totaled 305,000 kilowatts, the simultaneous maximum load on a unified system reaching these customers would be but 225,000 kilowatts. Such a system would show a load factor of about 48.7 per cent. Replacing the 437,530 kilowatts in small-plant capacity necessary to furnish the indicated service, with a unified system (allowing 20 per cent capacity reserve above the 225,000 kilowatts of maximum demand), a saving was shown as follows: 437,530 kilowatts in small plants, at $100 per kilowatt, $43,753,000; 270,000 kilowatts, unified, at $75 per kilowatt, $20,250,000, making a saving in investment of $23,503,000. In addition to this tremendous saving in plant investment there would be similar economies in operation, although it would be difficult to give a fair estimate of these without assuming special conditions, for under conditions of individual plant operation it is hardly conceivable that there could be obtained, either at all or on anything approaching a similar scale, such applications of electric service as unified operation makes possible.

Holding companies.—The other tendency of the period in the way of unification has been that exemplified in the creation of "holding" companies, now so much under discussion, whereby unrelated properties distributed widely over several states have been brought together under one central control and management, one of the objects and results being to invite capital by averaging the profits and losses over a wider area so that the risk of "putting all the eggs in one basket" is minimized or abolished. The number of commercial central stations in the United States in 1912 is given as 3,659. According to an authentic table,[2] the results of an investigation into the control or ownership of central stations in cities having a population of 5,000 or more showed 1,159 communities, in 528 of which syndicated properties of one kind or another were given service. It is not the intention here to discuss the political aspects of this problem, but to point out that under such centralized management there have invariably followed a renovation and enlargement of the properties, the installation of new apparatus, increase in service and facilities, and supervision by men of higher ability or attainments, each of whom is expert in his chosen field, furnishing, therefore, talent utterly beyond the power of a small plant to hire or retain. It is because of results shown in unification of the one kind or other that in such states as New York, where there are some 321 central station plants, it has been contended that the efficiency would be much higher and the cost of service to the public much lower if there were only 40 such plants, or even only 10. The distribution of electrical energy from this minimized

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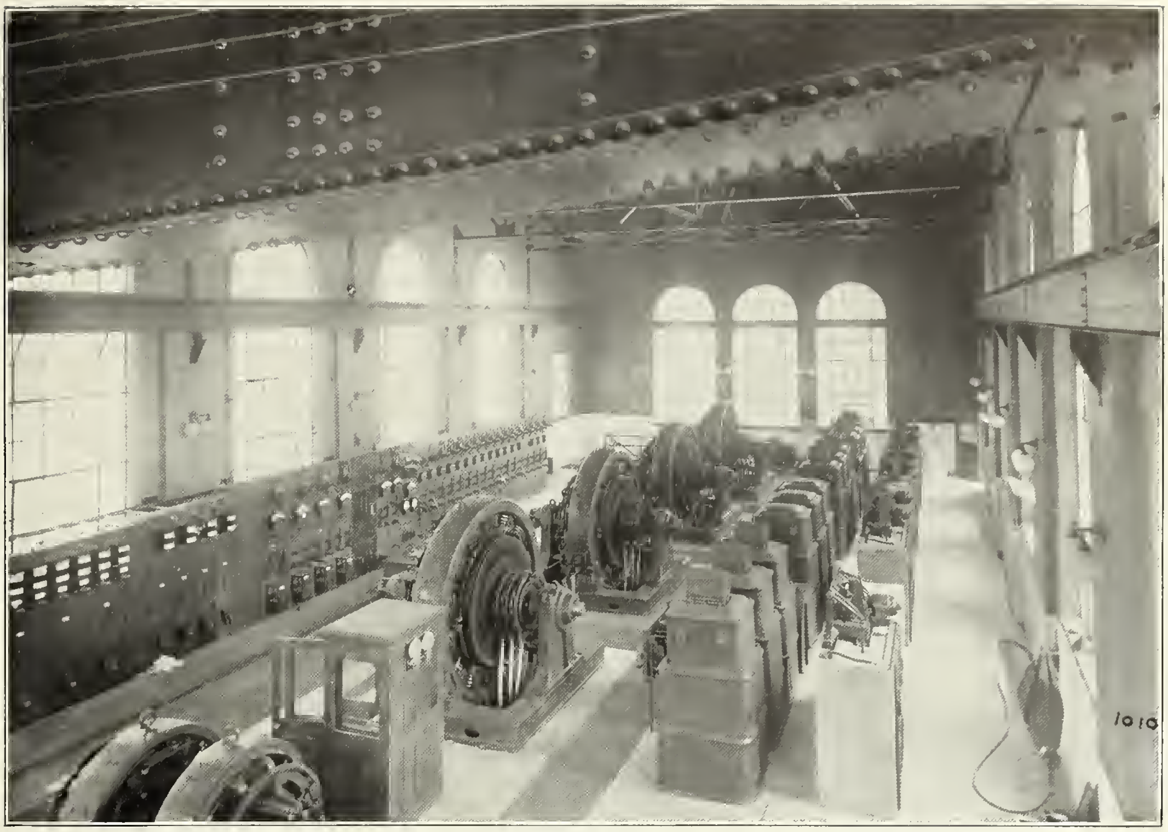
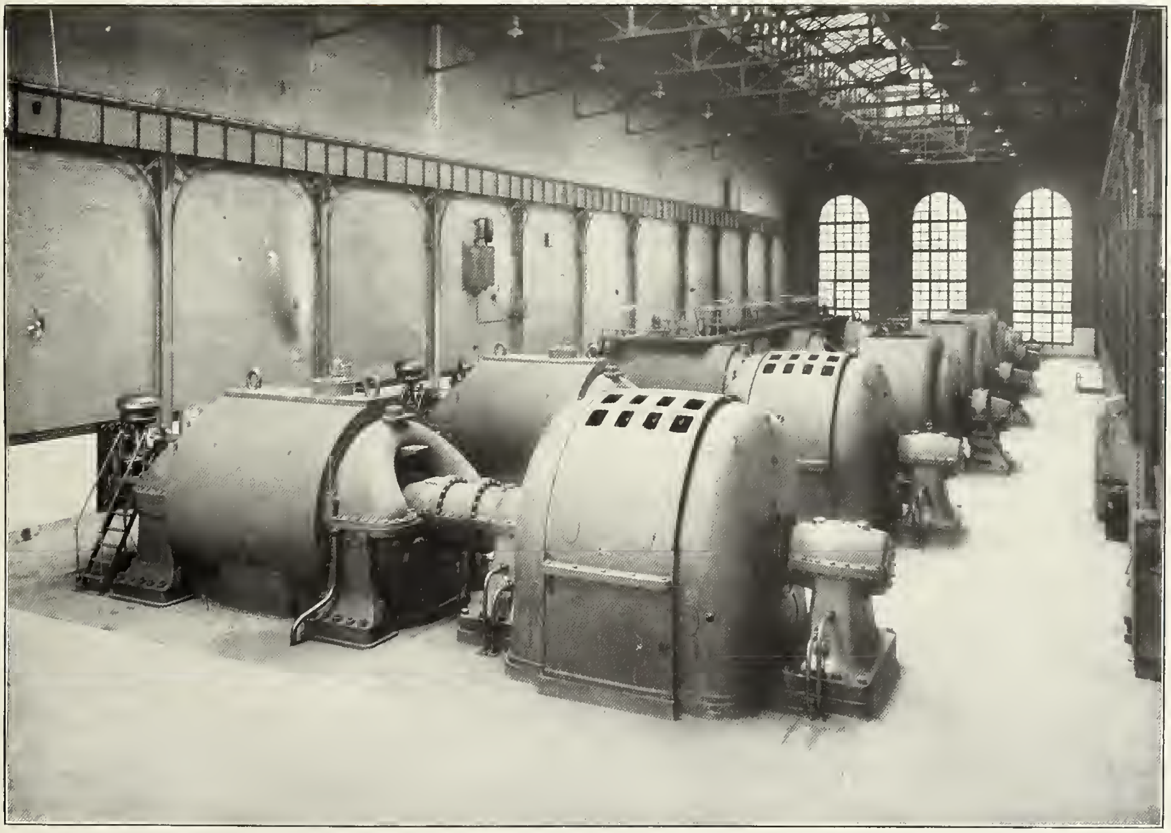
[1] National Electric Light Association, Report on Progress, 1913.

[2] Electrical World, Sept. 28, 1912.



1. 60-CYCLE ROTARY CONVERTERS, CLEVELAND RAILWAYS CO., CLEVELAND, OHIO.



2. STEAM TURBO-GENERATORS, LONG ISLAND RAILWAYS, LONG ISLAND CITY, N. Y.

(Face p. 112.)

number is easy of practice under modern methods of power transmission, and not at all necessarily dependent upon hydroelectrical development. It has been pointed out, for example, that in some of the small communities at the eastern end of Long Island, New York, coal costing the central station company only $1.15 per ton at the pit's mouth comes with a burden of $2.65 per ton freight charges when it reaches the company's coal bin, so that the best price the company can make to its customers is about 18 cents per kilowatt hour. The same little system fed from a substation could be operated much more economically from a large transmission plant at tidewater midway of the island, supplying a large area, or even from the steam-generating system of the Brooklyn Edison Co. at the western end of the island, 100 miles away.

Utilization of water power.—One further aspect of the enormous increase in the industry during the period 1902–1912 is the utilization of water power as a source of primary energy supply in driving the electrical generators. It is to be noted from the general table on the statistics of the continental United States that the number of water wheels employed more than doubled and that their horsepower increased 463. 6 per cent, or from 438,472 horsepower in 1902 to 2,471,081 in 1912. During the same period the horsepower of steam engines and turbines in the industry increased only 254.7 per cent, or barely half as much. Such figures, however, do not reveal the full extent of the tremendous development that has taken place in some states. Thus the statistics of North and South Carolina are nothing short of extraordinary. The increase in North Carolina in water-wheel capacity in the 10 years reached 2,500 per cent, while in South Carolina the increase amounted to not less than 1,614 per cent. The increase in North Carolina in the horsepower capacity of the stationary motors, served almost wholly from these water-power systems, was 3,356 per cent in the 10 years 1902 to 1912. In view of such figures, which have various implications as to their bearing on the art and science of power transmission, it is easy to understand the rapid development of many industries in the South requiring crude energy in large quantities.

Relationship between central stations and electric railways.—The interrelations, already close between the central station industry and electric street railway systems, have been much more strongly knitted by these developments in large power production, although not quite in the manner revealed in earlier reports. At one time there was a marked tendency toward the consolidation of lighting and traction properties, largely with the object of merging their power plants to secure higher economy in operation. Greater efficiencies were secured without doubt, but it has often been contended that the general quality of the service from the lighting circuits was not improved; or that the preoccupation of the management in the anxieties of running street cars hindered the light and power part of the business from receiving the full attention it required in order to give satisfaction to the public and grow at the highest rate attainable. Be this as it may, it is now certainly the fact that there is an increasing disposition to treat the matter the other way around, the street or interurban railway abandoning its own generation of current and buying it in bulk from the local central station. Chicago has been notably a leader in this development, and the Commonwealth Edison Co., which has steadily maintained that it is uneconomical to supply a given territory by more than one system of electrical energy transmission, has for several years supplied all the power requirements of the Chicago city railways and part of those of the elevated railways and the Chicago railways. Thus the railway portion of the total output of energy has become a very large percentage of the whole and is growing rapidly. But there are many other places where the same change has occurred, as, for example, in Cleveland, Ohio, where the Cleveland Railway Co. in 1912–13 put out of commission two large plants of nearly 5,000 horsepower in steam engines, and is now purchasing 60-cycle alternating current from the Cleveland Electric Illuminating Co., converting it into direct current for use on the street car lines, through 1,500-kilowatt rotaries, with the supplement of storage batteries. Even more striking is the instance of Philadelphia, where for some time past the Philadelphia Electric Co. has been feeding a load of 35,000 horsepower daily to the Philadelphia Rapid Transit Co. Adopting the same method, the Pennsylvania Railroad has made a contract with the Philadelphia Electric Co. for the energy used in the electrification of its lines between Broad Street station and Paoli, and also between Broad street station and Chestnut Hill. The contract is for five years. At the beginning the Pennsylvania Railroad will use about 4,500 horsepower, a minimum of 3,750 kilowatts with a load factor of 25 per cent being specified. The energy is to be furnished for the main line to Paoli and any addition or extension thereto, the railroad company reserving the right to call on the Philadelphia Electric Co. for any additional power that may be necessary for its general system from time to time. With the completion of the present work as planned, the Pennsylvania Railroad will have 32 miles of electrified lines in the Philadelphia suburban district.

The significant importance of this contract is that it carries with it a solution of one of the great difficulties encountered in the electrification of the steam railroads of the country. If each of the railroads were to put in its own power plants an enormous outlay in the aggregate would be necessary, and they are not in such financial position as to assume this burden, in spite of the conceded gains in volume and density of traffic due to electrification. But the lines in most parts of the country pass through towns and cities which already have large central stations capable of furnishing this energy to the respective sections of the track. In other districts where the population is sparse the lines are frequently near water-power transmission networks that could be tapped for this additional service. This latter work has, indeed, already been taken up in the Far West, and in the meantime, through the intermediary of the local central station system at Baltimore, some of the energy from the huge hydroelectric plant on the Susquehanna River, 40 miles away, is being fed into the circuits of the Baltimore & Ohio Railroad.

STEAM POWER.

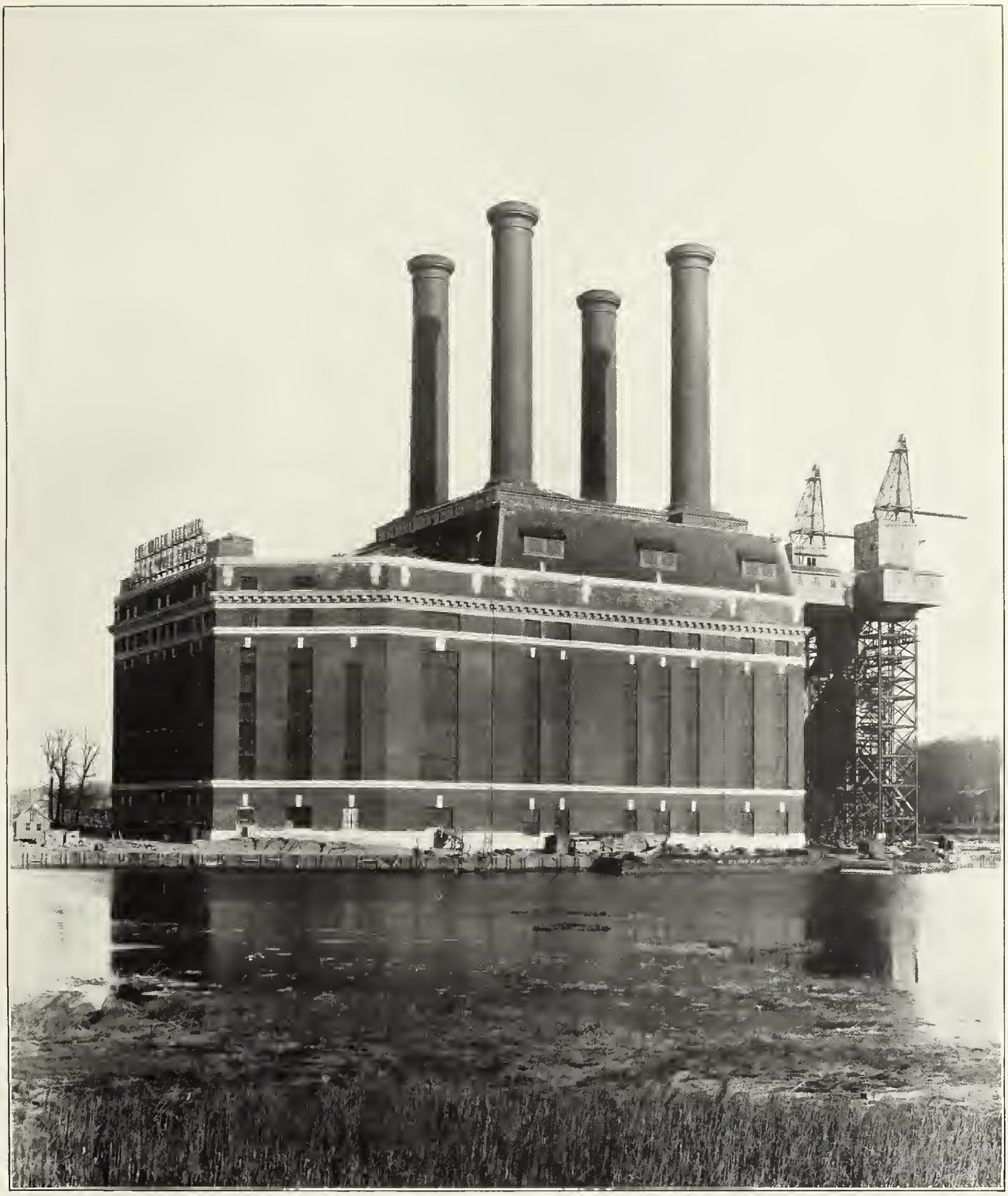
The general conditions as to steam power are discussed in Chapter III, and bear emphatic testimony to the vogue and supremacy of the steam turbine in central station work. Steam will probably remain the chief prime power for driving the generators of the industry, but the fact is not to be overlooked that while the total steam engine equipment in 1912 was 4,946,532 horsepower, that of the water wheels was 2,471,081 horsepower, and showed a gain in the 10 years of 463.6 per cent, while the steam increase was 254.7 per cent. The proportion of central station service given in urban communities is very large, and demands absolute reliability and continuity. Hence the exclusive use of water power is out of the question, and there is a growing practice of associating heavy steam-reserve equipment with hydroelectric installations, if only as an assurance of uninterrupted supply. A factory or a metallurgical plant might conceivably be deprived of power even for hours without serious loss or discomfort to any one. A train may be late and inflict temporary inconvenience upon only a comparatively few persons by its delay; but no large community likes to run the risk of being deprived suddenly, even for a short time, of its light, heat, and power. Thus few great central station systems to-day, however dependable may be their hydroelectric plants, are without a fair percentage of steam stand-by, if the companies are responsible for the continuous service of a considerable population; and hence the very increase of hydroelectric development generally brings with it an increase in steam plant that is reflected in these returns.

Tendency toward greater efficiency.—A general summary of existing conditions in steam central stations was made before the Association of Edison Illuminating Companies in September, 1911, by President T. E. Murray, dealing with reliability of service, operating economy, and structural excellence. Larger boilers have come into vogue, and the evolution of boiler furnaces is such that fuels heretofore considered worthless can now be burned to advantage. Stokers are less automatic but more efficient than formerly, and the growing scarcity of steam sizes of anthracite, rendering a greater use of bituminous coal necessary, carries with it a wider adoption of the mechanical stoker. The steam-piping systems in use are designed on the unit plan, with interconnecting mains and steam speeds of 12,000 feet a minute. Steam pressures still remain between 175 and 200 pounds, and the use of superheated steam is becoming more general. A great improvement in boiler feeding has followed the use of the centrifugal pump and accurate water meters, and open heaters and forced draft are most widely employed in later stations. The steam turbine has supplanted the reciprocating engine in large stations, and it is very doubtful if any more large reciprocating units will be installed for power-station purposes. Coming to the electrical equipment, the design is largely influenced by the character of the load and the distance to which energy is to be transmitted. In busbar arrangements, standard practice favors the group method of generator and feeder connections having two sets of busbars sectionalized at one or more points by switches. For bus and switch compartment work concrete is coming largely into use, but brick makes a more finished construction, while for high-tension switches, and for flooring high-tension compartments, soapstone is still the best available material.

The improvements made in protective devices and instruments for switchboards are noted, as well as methods of control which have worked well in practice, especially in stations having system operators or load dispatchers. As to operating costs, Mr. Murray stated that attention to station economics with large units and careful design has resulted in a station cost which is gradually approaching a minimum. He divided the cost of a fair-size station per kilowatt as follows:

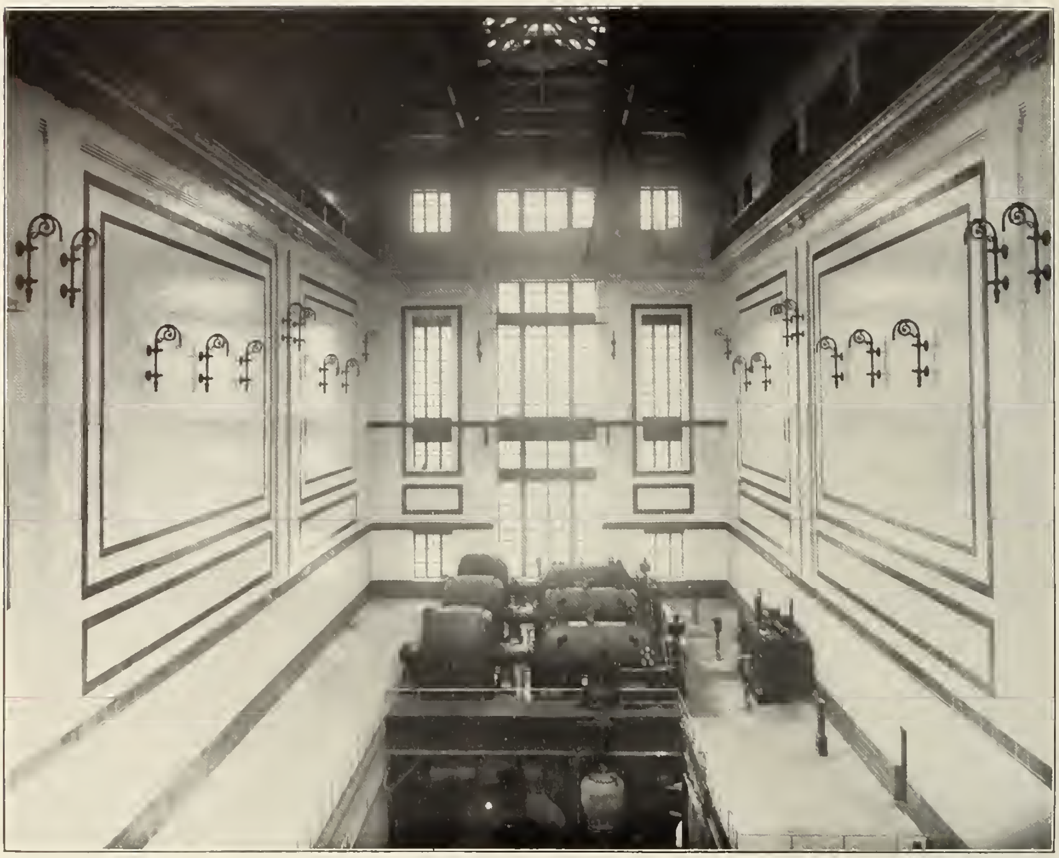
	Per cent.
Total	100
Building structure	30
Boilers, furnaces, and boiler room auxiliaries	20
Turbines, generators, and condensers with auxiliaries	25
Piping systems	10
Switchboard and other electrical work	7
Miscellaneous small items not otherwise included	8

The importance of striving after a low cost of construction per kilowatt of station capacity will be appreciated when it is considered that the effect of a saving in the station investment cost of $5 per kilowatt is equivalent to an annual saving in the coal bill of 12 per cent with coal at $3 a ton, where a fixed annual charge on the investment of 14 per cent is allowed to cover interest, depreciation, and taxes. It would appear, according to Mr. Murray, who spoke from a vast experience, that further gains must come from advances in the direction of reduction in cost, increase of output, and improvement in the load factor under which the stations operate, rather than in the efficiency of the individual units.

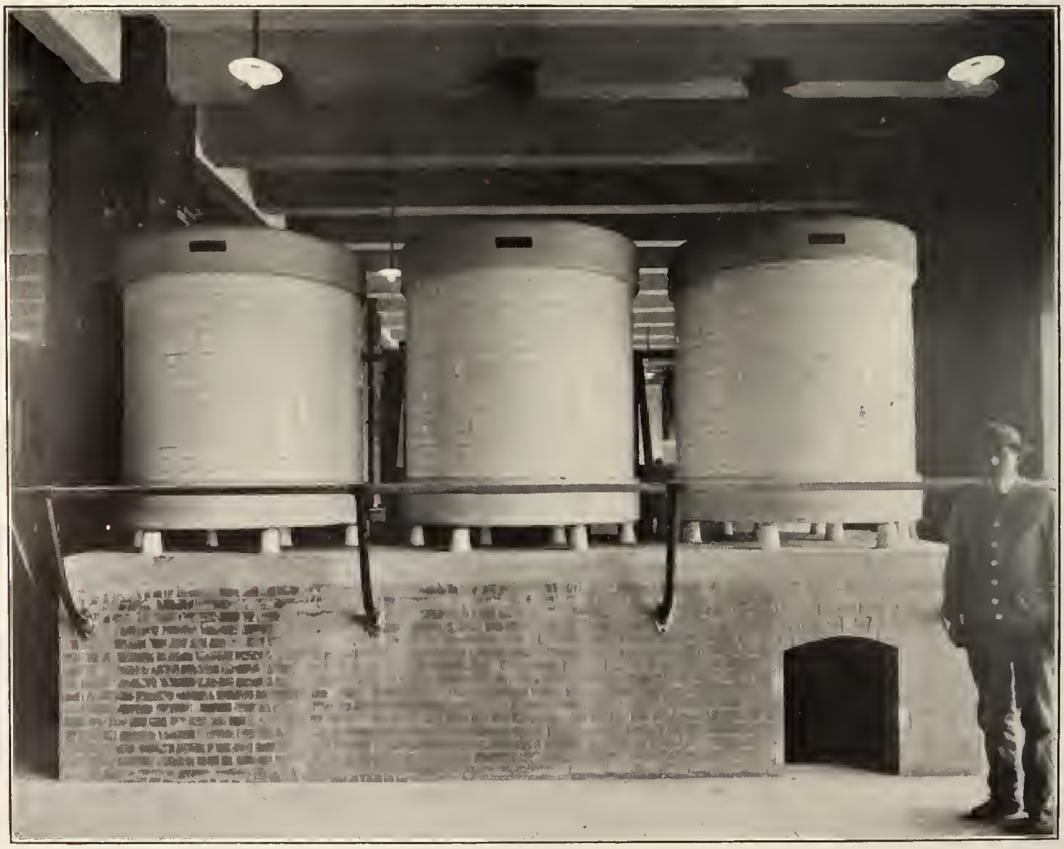


NEW GENERATING STATION, UNITED ELECTRIC LIGHT AND POWER CO., NEW YORK CITY.

(Face p. 114.)



1. GENERATING ROOM.



2. REACTANCES.

Facilities for obtaining coal and water.—Other aspects of the situation were noted by Mr. I. E. Moultrop, in the winter of 1912–13, before the Worcester (Mass.) Polytechnic Institute. It had been found, for example, that in the design of a large station wharf privileges having a channel of ample depth for coal carriers of large size and the avoidance of drawbridge tolls are important factors, and that an inland plant should, so far as possible, not be dependent upon a single railroad for its supply of coal. The coal-storage facilities should permit the holding of at least a month's fuel supply at all times and three months' supply in winter, to guard against interruptions. The supply of circulating water should be almost unlimited in a plant of great size. At the South Boston plant of the Boston Edison Co., with seven units in operation, 10,000,000 gallons of circulating water per hour were required to maintain the vacuum. The practice of drawing such water from a channel rather than from shallow places in a harbor is highly desirable. Although the cost of land is not the factor it used to be in connection with large stations, on account of the tendency to locate such plants outside the centers of cities, the burden of fixed charges carried by the real estate investment in plants of very high capacity is a factor to be considered with some care. While it is always possible to build a plant in a new location when the demand for service necessitates it, it is more desirable to extend a well located existing station, as this does not require a new operating organization or new coal-storage and wharfing facilities.

Boilers.—Water-tube boilers are the only kind suitable for large stations, and Mr. Moultrop held that units of from 500 horsepower to 750 horsepower rating are as large as is desirable. Engineers are not agreed regarding the desirability of very high-power boiler units, although these have made excellent records in the Delray station of the Detroit Edison Co. and in European plants. Large boilers complicate the question of spare equipment and are liable to the same troubles as the smaller units, so that a larger percentage of the total steaming capacity is taken from service in case of trouble with a boiler of large size. As to the general design of a central station and the selection of its equipment, Mr. Moultrop indicated the flexibility of methods and range of selection in an art already well standardized by stating that in a recent case as many as 25 preliminary station designs were made with the assistance and for the criticism of the operating department to which the station would have to be entrusted.

In connection with the resort to larger boiler units that should correspond in some degree to the larger turbo-generators in steam stations—a practice which, as the preceding paragraph shows, is not deemed fundamentally essential—reference should be made here to the 10 huge water-tube boilers installed in 1911–12 by the Detroit Edison Co. at its Delray plant on the river front. Each of these great units is rated at 2,365 boiler horsepower, on the assumed basis of 10 square feet of heating surface per horsepower, or 30 pounds of steam per horsepower hour. The Delray boilers have been tested up to 214 per cent of full load, which is equivalent to generating steam at about 7 pounds per hour per square foot—not an excessive evaporation for boilers in modern practice. Ordinarily the units carry 6,000 kilowatts to 7,000 kilowatts each. This load increases to 8,000 kilowatts per boiler during the peak periods, and for short durations has reached 11,000 kilowatts. Each boiler is 36 feet high, 30 feet wide, and 28 feet deep, being fired from both ends. The three huge steam drums are connected with the two mud drums by no fewer than 1,564 3¼-inch tubes. Each boiler has four water columns and an even dozen safety valves designed to relieve the pressure if it rises above the normal steam condition of 205-pound pressure and 150-degree superheat. At normal rating the big units have shown a combined thermal efficiency of 80 per cent (about 89 per cent being the maximum possible value), and this observed efficiency decreased only to 76 per cent at 100 per cent overload. It is held that the remarkable economies obtained could hardly be traced to exceptional flue temperatures or any other furnace conditions differing materially from ordinary experience. But the large units decrease the usual proportion of radiation losses, and, with their single huge fires, enable the closest attention to be given to the one bed. Labor costs are thus reduced correspondingly and the boiler-room layout is simplified and cheapened. The boilers themselves cost less per unit of rating than similar small units. Difficulties with furnace brickwork have apparently been solved as rapidly as they presented themselves. A series of tests on two of the Delray units was carried out under the direction of Dr. D. S. Jacobus, and formed the subject of a paper presented by him at the annual meeting of the American Society of Mechanical Engineers.[1] The test required the services of 50 men working in eight-hour shifts for six weeks. During this time 5,000 tons of coal and 45,000 tons of water were measured. The results obtained show that with the two kinds of stokers the combined efficiency of both boiler and furnace ranges from 80 per cent at slightly below normal rating to about 76 per cent at double rating. Such results are attributed not less to the skill employed in the test, the expertness of the stokers, and the careful selection of the fuel, than to the design and size of the boilers.

Size and power of turbines.—The notable feature in generating units in the last census period has been the increase in the size of the turbines as well as in the speed of revolution. At the time the present text went through the press the size of units had been carried to the highest point reached in the order given by the Philadelphia

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[1] Journal, American Society of Mechanical Engineers, November, 1911, p. 1437, et seq.

Electric Co. for two machines rated at 30,000 and 35,000 kilowatts, respectively, and with increasing rotative speeds even this is not regarded as at all the limit in capacity. The smaller of these units would supply the adjacent state of Delaware with all the current needed by all its public utility companies. In the meantime, the largest actual unit is one rated at 25,000 kilowatts, with a maximum rating of 40,000 horsepower, contracted for in England, 1911–12, by the Commonwealth Edison Co. of Chicago. This unit is of the horizontal type, the low-pressure end being double-flow. The unit is 75 feet long and 18 feet wide, with a speed of 750 revolutions per minute, the generating part being 25-cycle, 3-phase, 4,500-volt. The exciter is carried on the shaft, and the auxiliaries are of rotary type, electrically driven. This compares with a unit of 30,000 kilowatts of American manufacture ordered by the Interborough Co. (subway) of New York City, the high-pressure element being a single-flow turbine operating at 1,500 revolutions per minute, and the low pressure element being a double-flow turbine operating at 750 revolutions per minute. Another horizontal turbo-generator unit of American make, ordered by the Commonwealth Edison Co. for the Northwest station, is of 30,000-kilowatt capacity. The exciter will be installed on the shaft of the machine, and the over-all length of the unit will be 60.5 feet. The width is 18.4 feet, and the height 14 feet. The generator part is a 9,000-volt, 25-cycle, 3-phase machine, operating at a speed of 1,500 revolutions per minute, and designed for an output of 1,925 amperes per phase. The turbine is to be operated at a steam pressure of 230 pounds, with a supertemperature of 200 degrees Fahrenheit. The weight of the entire unit is about 1,000,000 pounds.

Meanwhile some very large units have been put in actual operation in steam central stations, as, for instance, in the Waterside plant of the New York Edison Co. on the East River, where in November, 1911, the first of three 20,000 kilowatt turbo-generators was installed. These generators are 4-pole, 3-phase, 25-cycle, wound for 6,600 volts. The normal speed is 750 revolutions per minute. They are direct-connected to six-stage vertical turbines, designed to operate on 175-pound gauge pressure, with a back pressure of 1½ pounds absolute in the exhaust chamber, and with steam superheated 100 degrees Fahrenheit. The steam consumption in pounds per kilowatt hour under these conditions is guaranteed to be as follows:

LOAD IN KILOWATTS.	Steam, pounds per kilowatt hour.	Total steam per hour, pounds.
10,000	15	150,000
15,000	14.4	216,000
20,000	15	300,000

The dimensions of the base of the machine are 17 feet 6 inches by 17 feet. The height above the base is 35 feet 7 inches, and the height of the foundation above the basement floor is 10 feet. Each machine weighs, approximately, 420 tons, the revolving parts weighing 112 tons. The runners are 13 feet in diameter, and the total number of steam buckets they contain is 7,200. It is interesting to note that the area occupied by one of the 20,000-kilowatt units is 297 square feet. The area occupied by the single 3,500-kilowatt engine-generator unit of the type displaced is 918 square feet, so that the unit generates, approximately, eighteen times as much power as the old reciprocating engine per unit of area occupied. Assuming that the turbine is fully loaded all day and that there is an evaporation of 9 pounds of water per 1 pound of coal, the unit will require 7,200,000 pounds of steam a day, and about 400 tons of coal.

While awaiting the installation of its huge new units above referred to, the Chicago Commonwealth Edison Co. had put into operation in the winter of 1911–12 its Northwest station with units of 20,000-kilowatt capacity. These are spaced 44 feet apart. The steam turbines are six-stage machines, and each one has 7,392 buckets. The outside diameter of the sixth wheel is 13 feet 2 inches, and it has a peripheral velocity of over 500 feet a second, or about 6 miles a minute. The guaranteed steam consumption, with steam at 250-pound pressure and 100-degree superheat, is 14 pounds per kilowatt hour at loads of 10,000 kilowatts and 13.45 pounds at a load of 15,000 kilowatts.

Combustion tests.—Two types of boilers are used at the Northwest station, one with a vertical pass for the hot gases and one with a horizontal gas pass. The purpose of using the two types is to give a thorough test to determine which is the better, with the idea of insuring practically perfect, therefore practically smokeless, combustion. Each boiler should be able to generate 30,000 pounds of steam an hour, and this requires a rate of coal burning of 4,500 pounds an hour under each boiler, so that in each second of time 300 cubic feet of air passes through the grate. With 60 boilers, all running at the maximum rate, the amount of air entering the grates each minute would be over 1,000,000 cubic feet. To avoid unpleasant drafts of cold air in winter, provision is made to admit air directly under the grates from the train shed below.

Use of lignite and low-grade coal.—The creation of the numerous hydroelectric plants included in this report has been of incalculable benefit not only in the utilization of resources hitherto utterly wasted, but in directing attention to the higher economies possible in the use of fuel, and to the employment of grades of coal regarded previously as too low in calorific values. The central stations of the country have played a large part in this branch of "conservation," and it is interesting to note how the ascending prices for anthracite and bituminous coal have thrown them back on lignite where this happens to be obtainable within a reasonable hauling range. The Denver Gas & Electric Co. may be cited as one instance of a large system utilizing lignite within "striking distance," as well as being an example of the large use of hydroelectric energy transmitted from remote water powers. A notable example of fuel economy has been witnessed in Pennsylvania in the creation of a large electric plant whose operation is based entirely on the use near the pit mouth of coal that is undesirable for transportation. Coal available commercially is sent away by track, but the residue is now being made by electrical methods equally serviceable for light, heat, and power over large local areas and with a minimization of the waste hitherto represented by huge culm piles.

As to the utilization of low-grade fuel, economical methods for the combustion of the brown lignite found in parts of North and South Dakota and Montana have received the attention of Government investigators. In a 40-page pamphlet, prepared by Messrs. D. T. Randall and Henry Kreisinger, of the United States Geological Survey, the results of a series of tests are presented and analyzed. The authors conclude that the combination of boiler and furnace setting which they describe gives good results with North Dakota lignite, and they state that steam can be produced with a fuel efficiency of 55 to 58 per cent of all the heat in the coal. They experienced no difficulty in working the boiler to full capacity. Equally good or perhaps better results could be obtained by the use of mechanical stokers. Although this fuel is generally considered unsatisfactory, they concluded that it might be used with fair economy under boilers at their full rated capacity.

The subject of the utilization of lignite received special attention at the meeting in 1912 of the Southwestern Electrical Association, at San Antonio, Tex., when many central station managers testified as to their success in its use, especially as compared with oil. Mr. E. W. Kellogg, of El Paso, declared that while the ordinary run of mine-slack refuse coal, averaging 10,500 heat units per pound, gave a dense black smoke when burned on ordinary grates, the Colgate lignite was practically smokeless, showing economies expressed in cents per kilowatt hour very much higher than those obtained with even the highest grade of steaming coal. Mr. R. C. Brooks, of Dallas, explained that lignite was usually not adapted for burning on automatic stokers, since it required a stronger draft than that ordinarily afforded. While it produced more ash, it was nevertheless found to be a satisfactory fuel, and at $1.33 per ton, delivered, compared well with Oklahoma coal at $5 per ton. The Texas lignite had to be transported about 65 miles, and in even that distance suffered considerable reduction in size through slacking. Mr. W. S. Rathell, of Waco, related the results of some comparative tests of lignite and oil made on a 150-horsepower boiler, six-hour periods being adopted. These tests showed 1 ton of McAlester slack to equal 3 barrels of fuel oil, while 1 ton of Rockdale lignite equaled 2.25 barrels of oil. Lignite-burning boilers had the disadvantage that they could not be forced. There was also an objectionable tendency to slacking in the lignite. As the result of all these drawbacks, the local company found it necessary to carry auxiliary fuel, fearing to depend upon the lignite coal alone. Chain grates for burning lignite were installed, but without success. The slow ignition of the fuel made it impossible to keep up steam pressure. An excessive amount of labor was also required in removing ashes, etc. Even when protected from the weather by sheds and roofs, lignite slacked and then ignited from spontaneous combustion. Mr. A. E. Judge, of Tyler, reported that his company had been burning lignite with success for three years, having changed from oil when the latter reached $3 a barrel to lignite at $1.90 per ton, with an incidental saving of about one-third of the fuel expense. At the outset lump lignite was used, but slack was afterward purchased at $1.40 per ton, about 10 per cent more being required to produce the equivalent heating effects of the large size. The fuel was burned under forced blast on a special grate having many small holes. The use of lignite had about doubled the cost of labor, so that the net saving of lignite over oil represented the difference between $1,000 and $600 per month in operating expense. From every viewpoint lignite had proved a success, and there had been no trouble in forcing the boilers thus fired up to loads well beyond their normal rating.

Dr. A. C. Scott, of Dallas, called attention to the marked difference in the qualities of lignite mined in different sections of Texas. The ash content of such lignite was of the greatest importance in producer operation. The combustion of lignite containing 7,500 to 8,000 heat units, at 60 per cent efficiency and $1.50 per ton, was about equivalent to oil fired at 75 per cent efficiency, the oil containing 18,500 heat units and costing $1 per barrel. The heat-unit value of lignite varied, however, with the conditions of mining, transit, etc. For the proper combustion of lignite, the grate bars should be at least 24 inches from the boiler shell, the exact distance depending on the moisture content of the fuel. Troubles with lignite as fuel had been due chiefly to slow burning, but this difficulty could be solved by mixing the fuel with bituminous material of a higher grade. Thus a half-and-half mixture of lignite and McAlester slack burned very well. To get full steaming capacity it was advisable to provide a Dutch-oven furnace and a high stack. The cost of handling lignite had averaged on test from 8 to 12 cents per ton, suggesting the employment of some simple and efficient conveyor. Comparing oil at 93 cents per barrel with lignite at $1.15, there was a saving shown in favor of oil.

Mr. John A. Walker, of San Angelo, told how his company had changed to lignite after oil rose in price from 95 cents a barrel to $1.15. After trying lignite for 18 months the use of oil was resumed, owing to the trouble of handling the lignite, which had to be hauled 1½ miles at an expense of $150 a month. Prof. F. C. Bolton stated that the three years' experience at the Texas Agricultural and Mechanical College had proved oil at $1 per barrel to be a less expensive fuel than lignite at $1.50 per ton. When available, lignite screenings were cheaper than either. Mr. Frank E. Scoville, of Laredo, said that while lignite required a larger boiler equipment for the same output, it was his experience while operating a plant at Austin that this low-grade fuel was more satisfactory and cheaper than cannel coal mined only 26 miles away. Another speaker declared, however, that wherever lignite was used some auxiliary means must be provided for forcing the boilers, and that some mechanical device had to be arranged for conveying the fuel from the cars to the furnaces.

Storage of coal.—Coal storage has necessarily received the attention of central station managers, as will have been gathered from various statements already noted above; and huge piles are now to be noted within the vicinity of modern plants. The adoption of under-water coal storage is one of the newer developments of the central station industry. Coal which is in open-air storage even six months may lose as much as 25 per cent of its fuel value, while there is always the tendency to spontaneous combustion. Coal can be stored under water, however, almost indefinitely without loss of its fuel value, and such storage offers an opportunity for holding large coal reserves almost indefinitely against a time of need. With this idea of guarding against strike or other shortage, and following expensive experience, the Omaha (Nebr.) Electric Light & Power Co. built in 1911-12 a large under-water storage pit capable of holding 10,000 tons, with the bunker contents enough for three months' operation of its 13,000-kilowatt plant. This storage pit measures 100 feet by 116 feet in plan and is 22 feet deep below the water level, which is in turn 23 feet below the crane runway. It will submerge 7,000 tons of coal, while 3,000 tons more can be piled on above the water level. The coal is unloaded from cars run alongside the pit by means of a grab bucket carried on a crane of 145-foot span. The coal car track passes directly above the hoppers leading to the coal crushers, which in turn discharge into the conveyors elevating the fuel to the overhead bunkers. This arrangement provides that the ordinary route of the fuel is from the cars to the boiler room, the storage pit always being kept filled with a fixed quantity of coal. The pit is of reinforced concrete and is carried on 400 piles at 5-foot centers driven to bedrock 19 feet to 30 feet below the semiliquid quicksand. The presence of this quicksand made it necessary to reinforce the structure for both internal and external pressures to prevent collapse of the pit when empty. The piles are capped with 2-foot 6-inch concrete slabs, reducing the stresses in the pit floor, which is 12 inches thick. Besides the steel reinforcing in the floor, old rails have been embedded in the concrete at 1-foot distances, their heads being flush with the waterproofed floor surface, to serve as an armor against the impact of the bucket when removing coal from the pit. The side walls are 4 feet thick at the bottom, tapering to 2 feet 6 inches at the top. The pit has been so constructed as to be capable of extension in both directions as the generating plant grows. Spanning the pit and the crusher hoppers, a total width of 145 feet, is a 5-ton bucket crane. This crane is made up of two girders 12 feet apart, between which runs the trolley carriage with its 2-cubic-yard bucket. The bridge is propelled by a 45-horsepower motor at 300 feet per minute, and the trolley is operated at a similar speed by a 16-horsepower motor. The main hoisting is performed by two motors, one of 45-horsepower and the other of 30-horsepower rating, giving a hoisting speed of 120 feet per minute. With this crane bucket a 50-ton car has been unloaded in 20 minutes. The cost of each handling of the coal is estimated to be about 4 mills per ton, whether from car to pit or from pit to crusher hoppers.

On account of the muddy sediment of the Missouri River, on the banks of which the plant stands, waste water from the plant supply (which has been allowed to settle in sediment basins) is used to fill the coal-storage pit. For draining the pit, outlets fitted with valves are provided just above the sewer level, so that the water can be drained to this point by gravity, beyond which the pump used to fill the pit can be brought into service for the purpose of discharging its contents into the sewer. This Omaha under-water coal-storage pit is estimated to have cost about $70,000, a part of this being due to the unusual and difficult conditions of quicksand on which the pit had to be foundationed.

A similar plant was built a little later by the Indianapolis Light & Heat Co., which stores 15,000 tons under water, while 15,000 tons more are just above water. The bin is 100 feet by 300 feet, and there is a depth of more than 20 feet below the water line. The concrete on the bottom and sides is 1 foot to 18 inches thick, reinforced with twisted steel; and the bottom has in addition a system of T-rail. The rail top stands half an inch above the surface of the concrete, and the rail is laid lengthwise of the bin, 18 inches from center to center; the intention being to protect the concrete from being destroyed by a lowered bucket when it is scraping for coal. A track runs across the top of the bin with a locomotive hoisting crane. The bin was excavated in plain gravel, and cost about $28,000, there being left gravel worth $4,000 available for other purposes, making the net cost $24,000.

Use of gas and oil as fuel.—An interesting plant in respect to fuel used is that of the Kansas Gas & Electric Co., at Wichita, whose capacity in 1911–12 of 8,750 kilowatts was based upon gas burning or oil burning, while the design permitted additions, if necessary later, for coal burning. The plant comprised turbogenerators and alternators. There were four boilers of the tubular type, each with 5,680 square feet of heating surface. The boiler furnaces were equipped with both oil burners and gas burners. They had very large combustion chambers and were of unusual size. They were fired from under the rear of the boilers on the side facing the turbine room, so that the turbine-room attendant might also care for the boilers, if necessary. There was a steel stack 14 feet in diameter and 199 feet 6 inches in height above the boiler-room floor, with the breeching placed in the base of the stack in such a manner that it would not be necessary to disturb it in case the station was equipped later for burning coal.

About four years ago, following the advent of natural gas into the city, the Fort Smith (Ark.) Light & Traction Co. began the use of this fuel instead of coal for its steam-driven generating station. Auxiliary provision had been made also for burning oil in case of low pressure or accident to the gas-supply lines. The cost of operation with gas at 8 cents per 1,000 cubic feet had been found to be just about equal to that of coal formerly purchased at $1.20 to $1.45 per ton. With the use of gas, however, there had resulted important savings in the cost of handling coal and ashes and in labor generally.

Magnitude and importance of central station work done by steam power.—Before passing on to a consideration of other forms of power, it is only proper to close this section of the report by noting how large and important the work done by steam remains in comparison. The table below shows the outputs, peak loads, and load factors of the central stations in Chicago, New York, Philadelphia, Boston, and Brooklyn for 1912.

SYSTEM.	DATA ON LARGE GENERATING SYSTEMS.			
	Peak load in kilowatts.	Date of peak load.	Yearly output in kilowatt hours.	Yearly load factor of system—per cent.
Commonwealth Edison	233,000	Dec. 11	799,000,000	43–44
New York Edison [1]	189,726	Dec. 20	513,926,429	30.8
New York Edison	210,813	Dec. 23	[2] 619,290,064	[2] 33.4
Philadelphia Electric [3]	65,489	Dec. 23	183,969,655	32
Boston Edison	60,143	Dec. 18	161,702,955	30.6
Brooklyn Edison	42,500	Dec. 17	125,770,000	33.7

[1] Exclusive of service to railroads.
[2] Including railroad load estimated for entire year.
[3] Philadelphia only.

The Commonwealth Edison system had the highest peak load and the largest output of the central station systems, owing to its great railroad load. The New York Edison Co. took over the load of the Third Avenue Railroad Co., approximating 28,000 kilowatts, but too late to make any impression on the yearly output. In this connection the output of the Niagara Falls Power Co. and the Canadian Niagara Power Co., which virtually constitute a single system, the stations being operated in parallel, is of interest. The peak load on that system occurred on March 8, 1912, and was 115,900 kilowatts. The output for the year, however, was 868,392,750 kilowatt hours, and the load factor of the system (ratio of yearly average to highest peak in year) was 82.29 per cent, making it in point of output the largest system in the world. The figures, however, did not reflect natural conditions at Niagara Falls. During most of the year the output of each of the plants was rigidly limited by the restrictions of the Burton Act, and during several months a part of the Buffalo load was supplied from the plant of the Toronto Power Co., at Niagara Falls, Ontario. Figures for the total output of Niagara would run far beyond those quoted, but at the best would show that the steam generation of electrical energy is comparable on terms of equality.

In regard to electric current transmission, it is also to be noted that steam central stations have demonstrated their ability to operate in this field successfully in a most surprising manner, and that it has been seriously suggested that electrical energy production wherever possible will take place at the pit mouth. To indicate what this might mean, it is sufficient to quote some figures given in his presidential address in November, 1910, before the British Institution of Electrical Engineers, by Mr. S. Z. de Ferranti, who suggested that there was feasibility, economy, efficiency, and greater public wealth in taking the 150,000,000 tons of coal then used in England miscellaneously and turning it all into electrical energy. He would furnish 131,400,000,000 kilowatt hours at a 60 per cent load factor from plants of a normal capacity of 25,000,000 kilowatts, and would group that apparatus into 100 stations, each of a capacity of a quarter of a million kilowatts, in 10 units of 25,000-kilowatt capacity each. The generating and distributing plants would require only 500,000,000 pounds sterling ($2,500,000,000). Instead of using up 150,000,000 tons of coal, these plants would require only 60,000,000, and taking all items into account Mr. Ferranti estimated that the public could be profitably served with current in some instances as low as one-fourth cent per kilowatt hour.

Meantime a good deal of just such work has been done in the United States. One example is furnished by the Empire District Electric Co., operating in the zinc and lead mining district of Missouri and Kansas, which at the time of this report had in service 9 generating stations, 19 substations, 100 miles of 33,000-volt transmission lines, and an equal mileage of 2,300-volt distribution circuits. It served, besides, the running needs of a scattered community of more than 150,000 people and 165 miles of interurban railway. This service of itself is not remarkable, but that it should grow and prosper where gas can be had for 25 cents per 1,000 cubic feet and coal is somewhere about $2 per ton speaks volumes for the practical advantages of electric power. Mining, however, involves peculiar conditions in the use of power, and experience has shown that under the circumstances of average use the power costs in mining run abnormally high. For instance, in one case of mine pumping it was found that even with fuel gas at only 12.5 cents per 1,000 cubic feet the actual fuel cost per 1,000 gallons pumped rose to 4.8 cents. When the steam pump was discarded and an electric pump was installed in its place, the cost for the power fell to 8.3 mills per 1,000 gallons. In addition to more than 100 pumping installations, many motor-driven air compressors were in use, with hoists and other equipment, bringing the total connected motor load up to about 25,000 horsepower.

Another instance is furnished from Iowa, where in 1909 the Bullock Public Service Co. bought the electric light plants at Missouri Valley, with a population of 3,000; Blair, Nebr., 3,500 population, distant 15 miles; and Logan, Iowa, 2,000 population, 9 miles distant. None of these plants were able to pay any returns on the respective investments. They were replaced by a modern plant of a 625-kilovolt-ampere steam turboalternator installed at Missouri Valley, and 16,500-volt transmission lines were built to Logan and Blair, with a 2-mile branch from the Logan line to Magnolia, Iowa, 300 population. A number of enterprising farmers who had been operating a gasoline plant built a 2-mile line to connect with the 2,300-volt local distribution in Missouri Valley for 24-hour service. At Missouri Valley 2,300-volt, 3-phase service was used for the local distribution, and at Blair and Logan 1,150 volts.

At a meeting of the American Institute of Electrical Engineers in Pittsburgh early in 1913 it was stated that the West Penn system had during 1912 no fewer than 76 coal mines on its circuits with an aggregate load of 14,831 horsepower, each mine finding it more economical to use central station energy than to generate electricity for itself. Another case is that of the Luzerne County Gas & Electric Co., at Kingston, Pa., which presents the very unusual condition of an electrical system, covering some 30 square miles of territory right in the heart of a coal-mining region, selling a great deal of electrical energy to the mines and buying coal locally at current prices. It is in effect hauling coal from the mines and delivering back electric energy more cheaply than it can be generated at the mine mouth. A somewhat singular set of circumstances led to the unusual results noted. To begin with, the coal costs from $1.10 to $1.30 per ton, delivered. The refuse and screenings available at the mouth of the mine would be cheaper than the buckwheat used, yet it appears that, on investigating the relative economics, the saving by using the cheaper coal had been found not so great as might be anticipated. In some instances this result was due to the scarcity of water supply at the mouth of the ordinary mine, and still more chargeable to the difficulty of utilizing very cheap fuel on a small scale. The economical burning of culm and similar fuel requires conveying apparatus on a large scale and can be best done in a plant much larger than the ordinary mine would require. Hence the central plant can afford to utilize cheap coal hauled from near-by mines and then distribute electrical energy back to the mines at a profit to all concerned. The coal is hauled to the station in carts and dumped into a large concrete coal bin, from which a motor-driven conveyor distributes it to the boiler room. It is not even burned on automatic stokers, nor are the ashes disposed of automatically, although an ash-conveying system has been installed. The operating conditions make the success of the plant in energy distribution all the more remarkable. The cost of fuel per ton is so low that any difference secured by a more expensive plant would make the economy a questionable one until the plant had to carry a much greater load. The requirements necessary with coal selling at $3 or $4 prove uneconomical with coal at $1.25.

Carrying out the same idea of a transmission system based on steam-driven generators, the Interstate Light & Power Co. went into operation in 1910 in the zinc and lead mining field in southwestern Wisconsin with a plant near Galena, on the Fever River, Illinois. This plant of 3,000-kilowatt steam-driven alternators delivered energy at 33,000 volts, 60 cycles, over 27 miles of line to three substations across the Wisconsin line, from which 2,300–4,000-volt secondaries fed a large number of mines through local transformers reducing to 220 volts. The region thus covered economically and successfully embraces over 200 square miles of hilly and rough country, where difficult haulage made the price of fuel extremely high, and where the local water was notoriously bad for boiler supply. Energy was sold at the mines on a scale of 8 cents down to 2 cents for all in excess of 80,000 kilowatt hours. A minimum charge was made of $1 per month per horsepower of connected load. The average rate secured by a mine consuming from 500,000 to 600,000 kilowatt hours was about 2.7 cents per kilowatt hour.

GAS AND OIL PLANTS.

Increase during 10-year period.—As the general statistics show, there has been a very large increase in the use of gas and oil engines in the central station industry, with percentage gains of 576.4 in number and 811.5 per cent in horsepower during the 10-year period. The figures for 1912 are 1,116 engines with a capacity of 111,035 horsepower. It will be noted the average units are not large.

Gas-producer plants.—Apparently no notable features require comment as to the use of engines dependent on illuminating gas, but other types have developed features of interest. Reference has been made to the use of lignite coal directly under the boilers of many central stations; but it has also been employed in gas-producer plants for gas engines, in spite of the trouble reported from plants required to meet sudden increases of load. The response of the producer to an increased demand for gas if the load rises quickly is generally sluggish, and the engine will therefore suffer from insufficient supply. This tendency of the lignite producer to balk under irregular load conditions has stood in the way of wider application where its low fuel costs and other advantages make it very useful.

In discussing the lignite producer before the Southwestern Electrical Association convention in 1911, Mr. W. B. Head, general manager of the Stephenville, Tex., Light & Water Co., recounted his own satisfactory experience during four years' operation, 24 hours daily, of a 100-horsepower updraft producer plant doing both electric lighting and water pumping. The performance of this equipment he characterized as unqualifiedly successful, whatever troubles were met with having been of a purely mechanical nature, such as might occur with any internal-combustion engine. The Stephenville plant had been run continuously 24 hours per day, except Sundays, when it was shut down 12 hours for overhauling. The cost of fuel, at 80 per cent load factor, had averaged under 5 mills per kilowatt hour. Unlike steam plants of equivalent sizes, producer plants of even very small ratings share the high efficiencies and the economies of the larger sizes.

The Blooming Grove (Tex.) Ice & Electric Co. had had a 60-horsepower lignite producer-engine plant in operation during the past three years. The early experiences were quite disappointing, and for a time the plant was virtually a failure, minor misadjustments or broken parts, the causes of which were often apparently undiscoverable, resulting in refusals to start or run; but in 1912 the plant was reported as being in satisfactory operation. Night electric lighting service for 100 customers and the town water supply were furnished by the producer engine, the waterworks pumps being run during the night hours after the evening peak had been passed. The plant equipment comprised a 60-horsepower gas producer providing fuel gas for a vertical, double 12-inch by 13-inch cylinder engine running at 290 revolutions per minute. A 35-kilowatt, 2,200-volt, 60-cycle, single-phase alternator was belted to the engine flywheel, and from clutch-driven extensions of the engine shaft the air-lift compressor and high-duty water pumps were driven. Lignite from the Beargrass, Tex., field had been used in the producer. This fuel cost about $1 a ton at the mine and $2.10 a ton laid down at the plant when contracted for in quantities. For this had been substituted Malacoff lignite from a nearer and newly developed field, costing $1.40 per ton laid down. The plant required about 1,500 pounds of lignite per 12- to 14-hour night's run, and about 20 carloads were used per year. During four to five months of the summer the plant was run 24 hours per day.

Natural gas.—There are various natural gas central stations in different parts of the country, but it is more particularly, perhaps, in the Southwest that one expects to find them. A successful small station of the kind is that of the Independence Electric Co., at Independence, Kans., a 775-kilowatt plant which in 1912 contained three different types of gas engines. In spite of cheap natural gas a number of the local industries were operated from the lines of the electric company, whose connected day load in motors was larger than its evening lighting peak. Under the average operating conditions of the Independence plant during a 30-day test, including periods of light as well as full loading, a kilowatt hour was produced for every 20 cubic feet of gas taken by the engines. This natural gas from the Oklahoma fields had a fuel value of about 950 pound Fahrenheit heat units per cubic foot. Under conditions of ½ to 60 per cent load at the time of another test, the engine produced a horsepower hour on 11.75 cubic feet of gas.

Oil engines.—With regard to oil engines, the data for the plant of the Citizens Electric Light & Power Co. of Lebanon, Ind., are of interest. Its self-igniting engines of the Diesel type had been in operation over six years in 1912. The principal equipment of the station comprised two 225-horsepower, 164-revolutions-per-minute, 3-cylinder engines, direct-connected to 160 kilovolt-ampere, 2,300-volt, 60-cycle, 3-phase alternators, and a 125-horsepower, 83-kilovolt-ampere, 225-revolutions-per-minute unit of similar type. The last of the larger units was installed in 1907, the other two engines having been in service since 1905. Each set was arranged with its own belt-driven exciter, and one engine could also be belted to an air compressor in the main engine room; but the compressed air for the plant was principally supplied by two motor-driven compressors in an adjoining room. At the rear of the plant building was the cooling tower for reducing the temperature of the engine-jacket water.

The fuel used in the engines was a partly refined heavy oil, testing 30° Baumé and containing about 19,000 pound-Fahrenheit heat units. From it the sulphur and other materials were removed. The oil cost 2.75 cents per gallon delivered in tank cars to the 11,000-gallon underground storage container, 30 feet south of the plant. The engines derived their immediate fuel supply from two 30-gallon steel tanks within the station, into which the oil was pumped by hand from the underground reservoir once every hour. The quantity of oil fed was exceedingly small. Under ordinary conditions the engines consumed from 10 gallons to 20 gallons of oil per hour, and produced 10 kilowatt hours per gallon of oil. The cost of producing a kilowatt hour in the Lebanon plant had averaged 2.8 mills for fuel oil alone and 1.9 mills for labor. Three men were employed about the station, but one of them gave only half of his time to the operation of the plant, having also outdoor charge of making arc-lamp renewals, overhead repairs, etc. Lubricating oil and waste averaged 0.2 mill per kilowatt hour.

The plant had an excellent load factor, its total output averaging about 41 per cent of the 24-hour equivalent of its maximum demand. During the eight hours of the working day its load due to motors averaged 78 per cent of its evening peak. Among the profitable power services supplied by this station was the city waterworks pumping plant, whose 60-horse power load occurred 18 hours daily during off-peak periods; a 25-horsepower planing mill, a 50-horsepower flour mill, and 60 horsepower in motors in a cream-separator factory. There was a total of 518 horsepower connected in 3-phase motors.

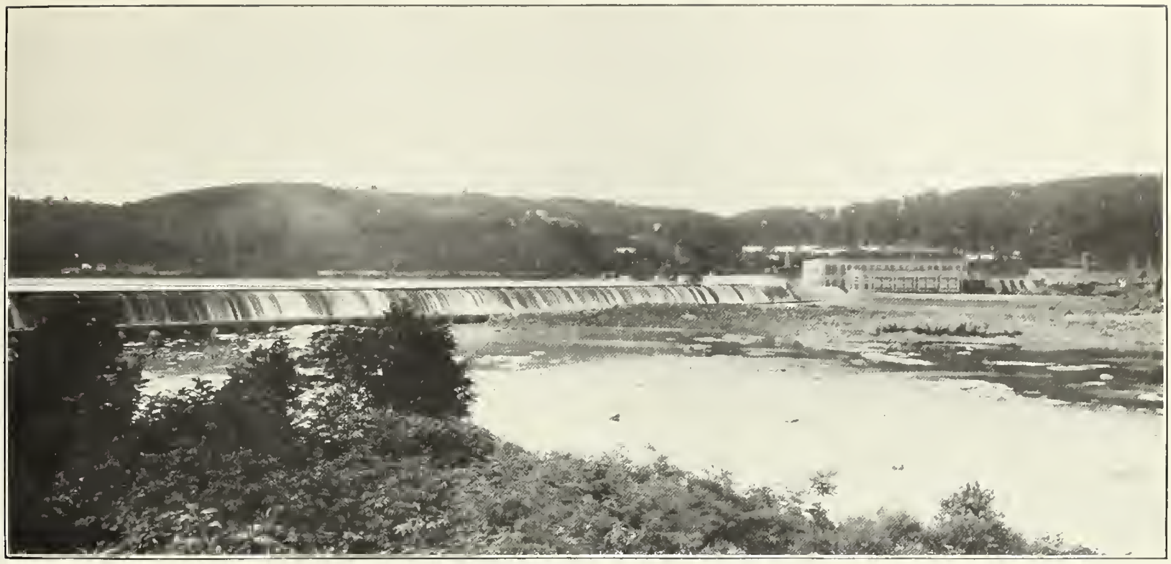
WATER POWER.

The remarkable extent of the development of water power in central station systems and transmission enterprises has already been referred to. It is true that the increase of such capacity applied separately to electric railways as shown by the statistics of that industry was no less than 859 per cent, but the total water power used by electric railways in 1912 was only 471,307 horsepower, as compared with 2,471,081 horsepower for central stations. This indicates that the railways as such have not gone in for the development of hydroelectric energy of their own on a large scale devoted specifically to street-car operation; a fact further established by the significant disclosure that with 6,000,000,000 kilowatt hours of current produced by railway power plants, nearly half as much more was purchased. Undoubtedly a large part of that came from central station steam plants, as in Chicago, New York, Boston, or Philadelphia, but a considerable proportion was taken from the hydroelectric systems whose output is embraced in this report, in the development of which, however, utilization in some degree by street railways was a factor. Thus the production of electrical energy at Niagara is registered entirely in the central station report, but the current itself not only is used in the operation of the local street railways, but is delivered for traction purposes at Buffalo, Rochester, Syracuse, and other points.

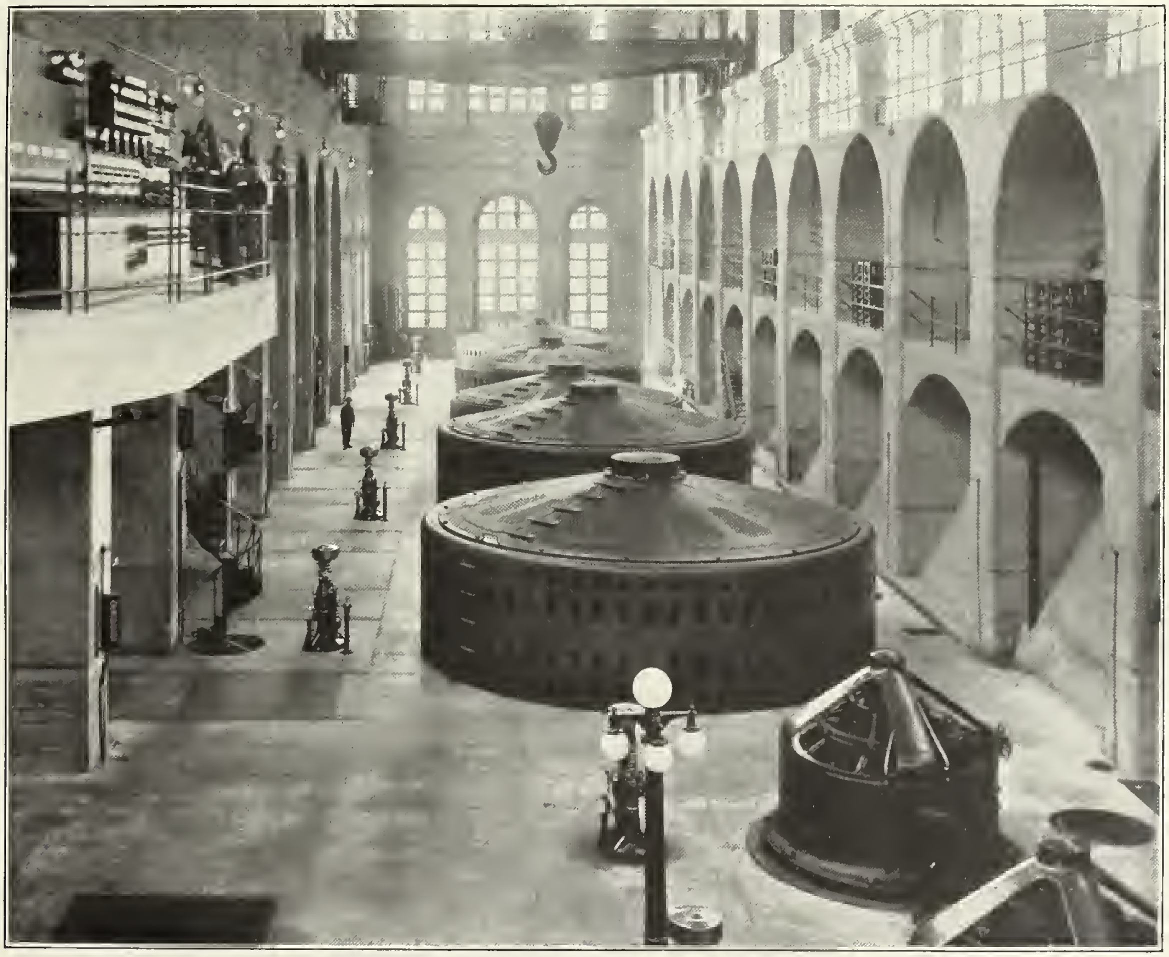
While the period covered by this report included some extraordinarily large and important enterprises, to which attention will now be called, it is worthy of note that few such have been of recent origin, one reason being that their construction and maintenance has proven in many cases expensive and unprofitable, as exemplified by two of the undertakings whose large financial requirements had much to do with the panic of 1907. It is also maintained that the restrictions and onerous regulations thrown around water-power development of later years with the idea of protecting the public have operated as a severe check, driving away capital that at best has had a poor return from this form of investment, and thus leaving the powers to remain wasted and the water still to flow idly to the sea. This is not the place to discuss the various political features of the "conservation" movement, but there is an obvious relation between the advance and perfection of such an art and the manner in which the investor is invited or repelled. If one feature more than any other could be said to arrest the gaze of the observer in the central station field to-day, it would be that of the consolidation into one system of numerous small plants in a given territory, requiring the application to ordinary central station operation of the principles and practices that hitherto have applied to pure power-transmission systems. It was the habit, only a few years ago, to think of central stations and of power-transmission systems as things apart. To-day, so swift is the march of events and improvement in the field, the two arts are found overlapping, blended, merged, and the whole revolution is predicated upon the conservation and utilization of hitherto wasted resources of power, upon the greater economy possible in dealing with existing equipment, and upon cheaper, better service to the public. At the water-power conference of the National Electric Light Association held in New York in April, 1911, and addressed by Secretary of the Interior Fisher, it was stated by the chairman, Mr. Henry L. Doherty, that over 33,000,000 unreservoired horsepower of hydroelectric energy still awaited development in the United States, and that at least $200,000,000 a year could be saved in coal, but that $7,000,000,000 would be required to create the necessary plants.

Pennsylvania Water Power Co.—The notable water-power plants of the period have been of both high and low head. One of the most striking is that of the Pennsylvania Water & Power Co. at McCalls Ferry, Holtwood, Pa., on the Susquehanna River, which, next to the St. Lawrence, is the largest stream flowing into the North Atlantic, drains 27,000 square miles, and takes up the annual precipitation over that area of approximately 42 inches. One of the largest in the

PENNSYLVANIA WATER AND POWER CO., McCALLS FERRY, PA.

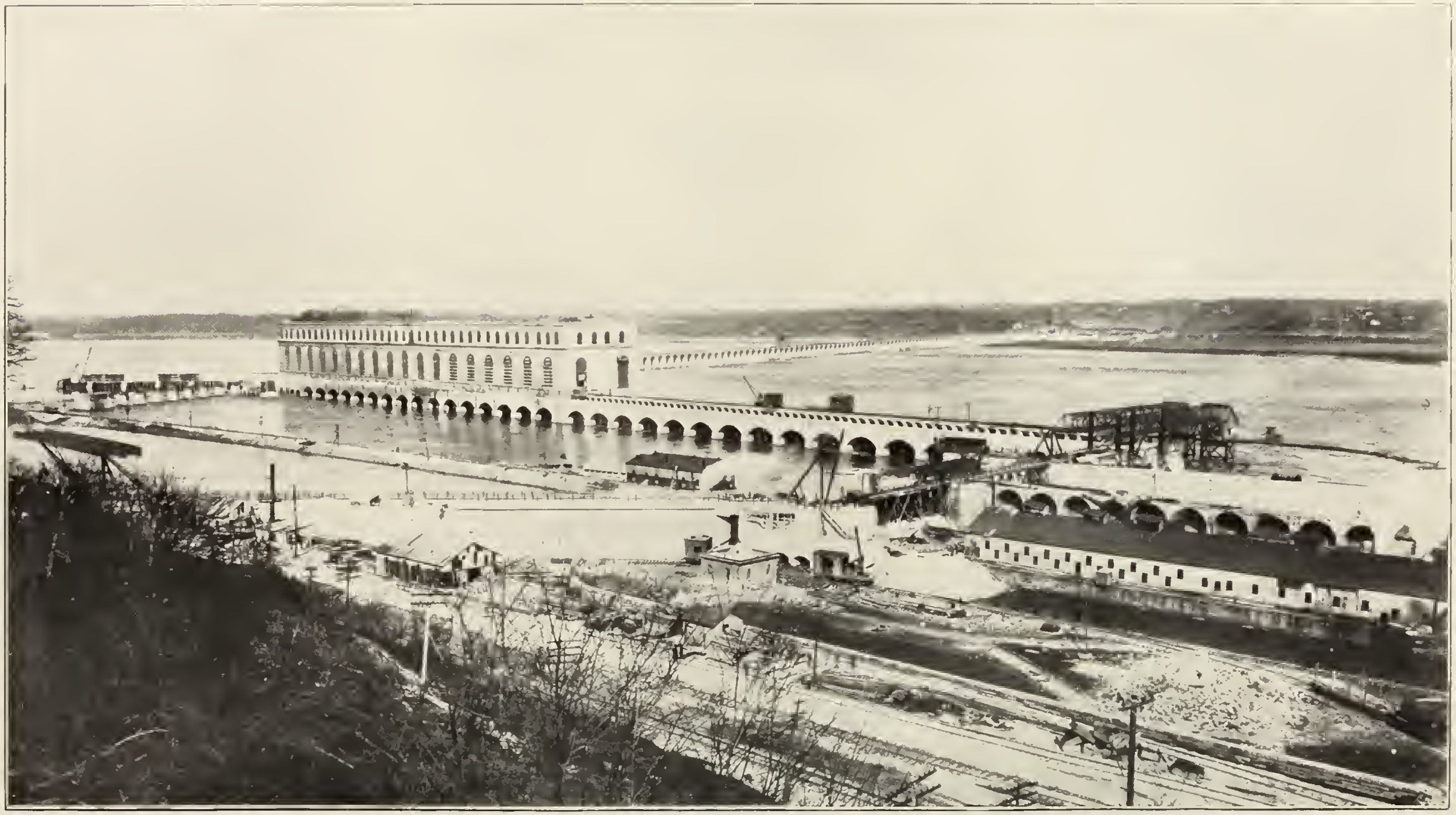


1. POWER HOUSE, SUSQUEHANNA RIVER.



2. GENERATING STATION, FIRST FIVE MAIN GENERATORS.

(Face p. 122.)



POWER HOUSE, MISSISSIPPI RIVER POWER CO., KEOKUK, IOWA.

world, the dam is half a mile in length, and is built of solid reinforced concrete with an average height of 55 feet and a base width of 65 feet. The storage reservoir thus formed covers an area of more than 3 square miles. The power house is also built of reinforced concrete at the easterly end of the dam, and is itself no less than 500 feet long, providing space for 10 hydroelectric units with a total maximum capacity of 120,000 horsepower, 7 being installed. The first five water wheels were of the vertical type, 15,300 horsepower each, and the later ones, of the same type, have by change of design been carried to 18,000 horsepower each. The generators are 3-phase, 25-cycle, 11,000-volt, the largest having a capacity of 12,000 kilowatts each, with the water wheels at 94 revolutions per minute under 53 feet head and 80 per cent gate opening. These are unusually large units for hydroelectric work.

Within a radius of 75 miles of the plant over 750,000 horsepower is being developed by steam, indicating the size of the market to be supplied. A large amount of power has been supplied to the Consolidated Gas, Electric Light & Power Co. and the United Railways & Electric Co. of Baltimore, 40 miles away, as well as to the Baltimore & Ohio Railroad. The Edison Electric Co. at Lancaster, Pa., 20 miles away, is also supplied. The first transmission line to Baltimore on a 100-foot right of way has 500 steel towers ranging in height from 58 to 120 feet, carrying two 70,000-volt circuits each consisting of three aluminum cables. This line is to be duplicated, owing to the rapid increase in demand for energy. The receiving substation in Baltimore has transformer capacity to handle 80,000 horsepower and provision for an ultimate 100,000 horsepower.

Mississippi River electrical development at Keokuk, Iowa.—The completion of this immense hydroelectric enterprise, involving an expenditure of about $25,000,000, was one of the notable engineering achievements of 1912–13. The plant of the Mississippi River Power Co. at Keokuk, Iowa, is one of the largest that have ever been undertaken in this country and ranks highest among the plants of its kind in the world. It is located at the foot of the Des Moines Rapids, a dam having been constructed across the river between the cities of Keokuk, Iowa, and Hamilton, Ill., and the power house erected on the Iowa side. The history of the project of developing power from the Des Moines Rapids dates back as far as 1848, but no success attended the various attempts until in 1899, when the Keokuk & Hamilton Water Power Co. was organized, with a capital of about $2,500, raised by the sale of stock. The city councils of Keokuk and Hamilton were applied to for help, and by unanimous consent of the citizens $7,500 was appropriated and turned over to the promoting company, every cent of which has been paid back to the city treasuries. With these funds at their disposal further investigations were carried on, and Congress was applied to for a franchise, which was granted early in 1905 after a thorough investigation to safeguard the rights of the public. In the early part of 1910 sufficient capital had been assured for the larger enterprise, and the actual work on the construction was started on January 5, 1910, just 30 days before the franchise expired. The Mississippi River Power Co. was formed in the spring of 1911 to succeed the old Keokuk & Hamilton Water Power Co., and is now the owner of the entire plant and equipment. Current was delivered to St. Louis on July 1, 1913, as provided by contract made long before this water-power development was even an assured project.

The ultimate capacity is 300,000 horsepower. The present power-house installation comprises only one-half of the final equipment, although the substructure of the building is complete for the second section, which will be erected as soon as the demand for additional power warrants it. Several transmission lines have been erected, one 110,000-volt line covering the territory along the river as far south as St. Louis, 144 miles from Keokuk; one 66,000-volt line from Meppen to Alton; two 33,000-volt lines, one to Hannibal and one to Quincy; and one 11,000-volt line covering the territory up the river to Burlington. The bulk of the present energy is disposed of in St. Louis, where 60,000 horsepower is contracted for on a 99-year lease.

The plant consists of the dam across the river, the power house, a navigation dock and dry dock, a retaining wall for protecting the railroad tracks, and an ice fender—all one concrete mass with a total linear dimension of 2½ miles. One of the restrictions made by the Government when granting the franchise was that a deep waterway must be maintained, the old locks, dry dock, and canal being submerged under many feet of water with the new development. A lock and dry dock had therefore to be built by the water-power company and ceded free of cost to the Government, which has complete ownership of them. The lock, 400 feet long and 110 feet wide, is one of the largest in existence, the width being the same as that of the Panama Canal locks. Power for operating both the lock and dry dock, as well as the machine shops, is also furnished free from a separate turbine-driven air-compressor plant built by the company and turned over to the Government.

The dam is of the gravity type, built of mass concrete without reinforcement and keyed down into the limestone bottom of the river about 5 feet. The structure, including the east and west abutments, has a total length of 4,649 feet, a width of 29 feet at the top and 42 feet at the bottom, and a height from the bottom averaging about 53 feet. It comprises 119 equal spans, consisting of arches supported on piers between which the spillway sections are placed. The structure therefore acts as both a bridge and a dam, with the water flowing over the spillways beneath the arches. The piers are 6 feet wide, and the spillway sections 30 feet long and about 32 feet high. In designing this dam the extreme variations in the stream flow of the river had to be provided for, varying from a minimum of 20,000 cubic feet per second to a maximum of 372,500 cubic feet. While the normal operating head is 32 feet, this will vary from 21 to 39 feet from high to low water.

It was also necessary to limit the water level above the dam to prevent flooding of such land as had not been included in the flowage lands. The height of the spillway has therefore been designed to take care of the limit of the upper level. In order to keep the water above the dam at a constant level with smaller flow, steel gates have been provided on top of all the spillways. In extreme high-water periods these gates are all open, while at lower stages a sufficient number will be closed to maintain the pool above the dam at the proper level. The spillway gates are built of steel truss framework faced with steel plates, and they are raised or lowered by means of two electrically operated derricks, traveling on a track on top of the dam. Two standard-gauge railroad tracks previously used for construction are also located on the dam and serve the gates. The erection of this dam across the Mississippi River at Keokuk has formed a lake which covers an area of approximately 43,000 acres. It extends 65 miles upstream to Burlington, Iowa, and varies in width from 1 to 3 miles. Navigation for this distance, which formerly was very difficult during low-water periods, has therefore been greatly benefited.

The power house is located some distance from the Iowa shore, the intervening space forming the forebay. It lies almost parallel with the river, and the water runs through the intakes and draft tubes nearly at right angles to the river flow, resuming its normal direction in the tailrace, which is excavated in the river bed from the upper end of the power house along its entire length and for some distance beyond the downstream end.

The total length of the power house is 1,708 feet. It has been completed to its full height on the forebay side for the entire plant, including the future extension, while on the river side the downstream half has been built above high water. It includes, however, the draft-tube openings for the future units.

The width of the building is 132 feet 10 inches, and the total height 177 feet 6 inches, of which the height of the substructure to the generator floor is 70 feet and to the transformer floor 78 feet. The height of the generator room is 68 feet, which gives ample head room for the traveling cranes, and makes it possible to take out the turbine runners with their shafts and carry them to the repair shop at the end of the generator room.

To gain head, and in order that the draft tubes might always be covered with water, the power-house foundation has been extended down in the bedrock of the river about 25 feet below the limestone bottom. The substructure is built entirely of concrete, the intake, scroll chambers, and draft tubes being moulded in. It contains 211,400 cubic yards of concrete.

The superstructure is a reinforced concrete building of massive, dignified design, containing four floors. The generator room is located on the main floor along the river side. The exciter sets and transformers are installed in compartments in the center of the building, while the gateroom occupies the shore side of the building. The floor level for the exciter, transformer, and gate rooms is 8 feet higher than the floor of the generator room. For the low-tension switches, busbars, and reactances, there are provided two narrow mezzanine floors in the center of the building. Except at the ends, where additions are built out over the generator room to accommodate offices and store rooms, the fourth floor extends for the entire length of the building on the shoreward side only. This floor contains the switchboard-control room, the 110,000-volt switches, busbars, and lightning arresters.

From the forebay the water enters each turbine through four intakes converging into a scroll chamber moulded in the concrete around the turbine. The design of this spiral-formed scroll chamber and the intakes has been made very carefully in order to insure an equal velocity and force of the water all around the circumference of the wheel and thus obtain the highest efficiency possible. Three of the intakes for each turbine are entirely separate from the fourth, uniting in a common passage some distance from the scroll chamber for passing the water to the farther side of the wheel, while the fourth intake supplies the water to the near side. The scroll chamber has an average diameter of 39 feet and a height of 22 feet.

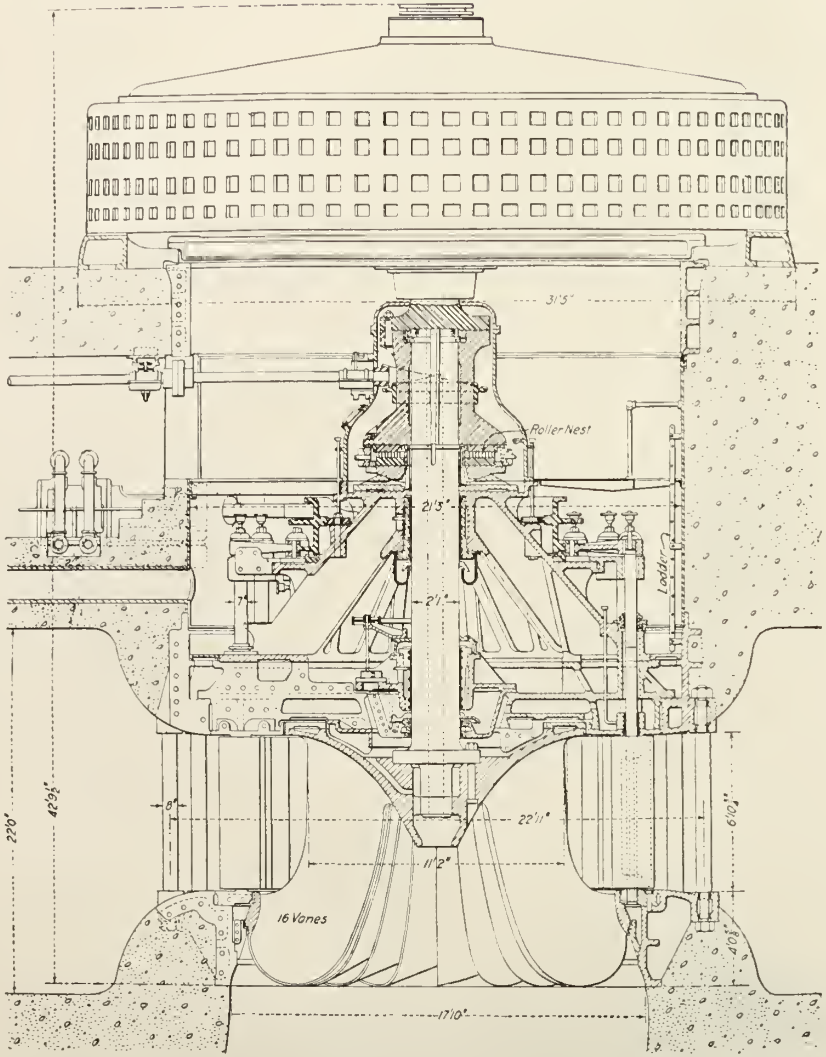
The outer openings of the intakes, which are 7½ feet wide by 22 feet high, are provided with steel gates sliding in cast-iron guides. For raising these gates, as well as the screens, a 75-ton traveling crane is provided, running the full length of the gatehouse. For lowering the gates, however, there is a separate brake mechanism for each gate. The water from the turbines is discharged to the tailrace through concrete draft tubes. These are about 60 feet long, gradually curved from a vertical to a horizontal direction. The foundations at their outlets are about 25 feet below the normal river bed. The draft tubes have a diameter of 18 feet at the wheels, but their cross section changes from a circular shape at this point to an oval at the outlet, the tailrace openings measuring 22 feet 8 inches in height by 40 feet 2 inches in width. This enlargement and change in shape is calculated to reduce the discharge velocity

MISSISSIPPI RIVER POWER CO., KEOKUK, IOWA.

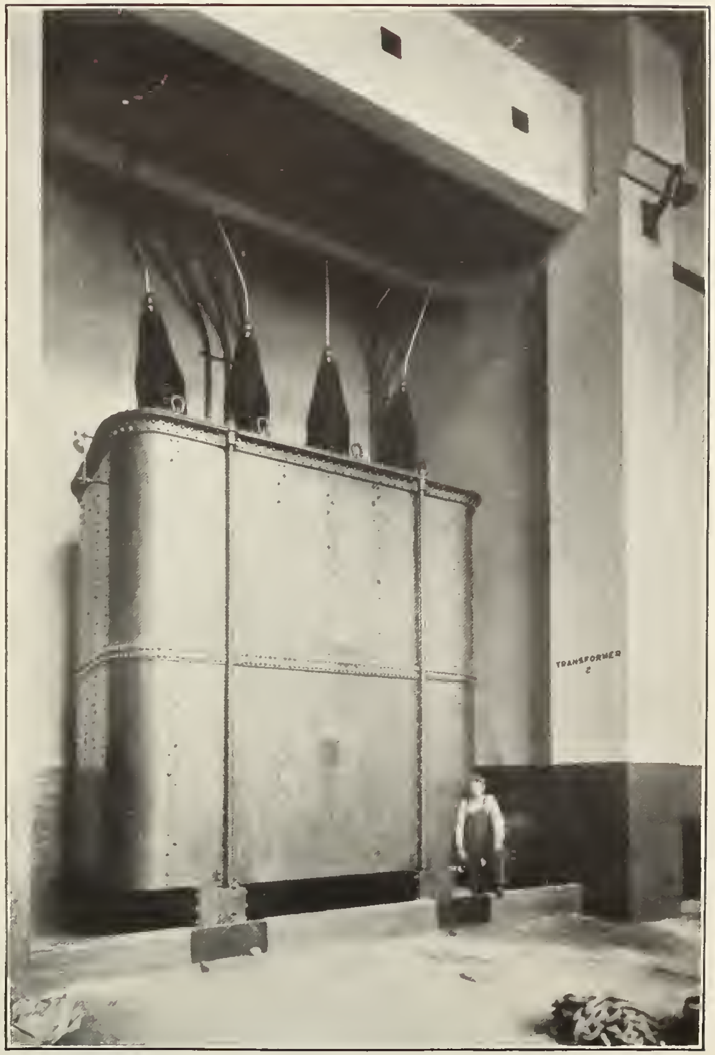
1. GENERATING STATION.

2. CONTROL SWITCHBOARD.

(Face p. 124.)


3'5"
Roller Nest
2'5"
2'1"
Ladder
7"
22'0"
42'9½"
8"
22'11"
11'2"
6'10¼"
16 Vanes
4'0⅜"
17'10"

1. CROSS SECTION OF 10,000-HORSEPOWER VERTICAL SHAFT SINGLE RUNNER TURBINE.


TRANSFORMER
2

2. NINE THOUSAND KILOWATT-AMPERE TRANSFORMER
(110,000 Y 11,000).

of the water to four feet per second at the outlet into the tailrace.

The initial installation comprises 15 turbines of the vertical single-runner type with a normal rating of 10,000 horsepower each, based on a head of 32 feet. Their design is, however, such that they will operate efficiently with a head varying from 21 to 39 feet. The actual speed is 57.7 revolutions per minute, the specific speed 338, and the maximum efficiency at normal head about 88 per cent.

The turbine itself is placed at the bottom of a large concrete-encased steel cylinder called the pit liner. Bolted to the upper and lower ends of this steel shell are large cast-iron rings, weighing 30 to 40 tons each, which support the entire weight of the unit, or approximately 1,000,000 pounds. Each turbine has 20 cast-steel guide vanes, which are placed just below the pit-liner cylinder between two heavy cast-iron foundation rings, which are separated by 8-inch bolts.

Each runner has 16 vanes, the outside diameter at the bottom being approximately 17 feet and at the top 12½ feet, the length being 11 feet. The runner is mounted on a forged-steel shaft, which has a diameter of 25 inches and is coupled to the generator shaft above. The weight of each runner alone is 64 tons, while the weight of the total revolving element, including the water thrust and the generator field, is 275 tons. This weight is carried by a thrust bearing at the top of the wheel and below the generator, the bearing being supported from the upper foundation ring. Two guide bearings are also provided for each turbine unit. Two different kinds of thrust bearings are used. Twelve of the units are equipped with combination oil-pressure and roller bearing. Under normal operation, oil is forced between the two bearing faces at 225-pound pressure, separating these by a thin film of oil, on which the revolving element is supported. However, if for any reason the oil pressure or supply should fail, the upper bearing plate will settle down on a set of oil-immersed steel rollers, which will then carry the weight of the rotating element without interrupting the operation. The three remaining thrust bearings require lubrication at only atmospheric pressure.

For lubricating the pressure-type thrust bearings each unit is provided with a separate triplex oil pump chain-driven from the governor shafts and having a capacity of 150 gallons per minute at 225-pound pressure. A central oil-supply system for the thrust bearings is also installed, to be used in case of emergency. This consists of two motor-driven triplex oil-pressure pumps located in the main pump room and pipes to the different bearings.

The lubricating oil for the guide bearings is furnished by either two water-wheel driven or two motor-driven pumps. The oil is pumped to large tanks, whence it flows by gravity to the bearings and thence to reservoirs under the lower bearings. From the reservoirs it is pumped to the filtering and central supply tanks.

The oil can also be simultaneously pumped directly to the bearings and the gravity tanks. Revolving indicators, designed on the principle of water meters, are inserted in the piping leading to the guide bearings of each unit. These indicators are so adjusted that a certain number of revolutions correspond to a certain quantity of oil. Thermometers have been inserted in the ingoing and outgoing oil-supply pipes for each unit.

In addition to the main units there are two smaller turbines for driving the auxiliary generators furnishing power to the motor-driven exciters. These turbines, of the vertical type, have a capacity of 2,200 horsepower and a speed of 125 revolutions per minute.

The regulation of each turbine is accomplished by a specially designed oil-pressure governor, the balanced guide vanes being controlled through an exposed operating mechanism from the actuators, which are located on the generator floor in front of each unit. The operating mechanism consists of a rocker ring carried on ball bearings and connected by links to the cranks on the guide vane stems. The rocker ring is operated by means of piston rods from two high-pressure regulating cylinders, which, together with the relay valves, are located on the thrust-bearing floor. Under 200-pound oil pressure, these cylinders develop 250,000 foot-pounds, and the oil pressure is furnished by a separate induction motor-driven triplex pump for each unit. This pump and motor, as well as the accumulator and receiving tanks, are also installed on the thrust-bearing floor. By means of automatic control the pump is started up if the pressure falls below 140 pounds and continues to run until it has reached 180 pounds. The speed-control element and the anti-racing devices are installed in the governor pedestals on the main floor, and the governor fly balls are driven mechanically from a countershaft. On the governor pedestals are mounted various gauges indicating the oil pressure, the gate opening, and the speed, while the automatic regulation can be changed over to hand control if desired. The governor mechanism is also equipped with a motor connected electrically to the control switchboard, in order that the switchboard operator can control the speed of any unit when synchronizing. The governors maintain the speed steady within one-half of 1 per cent, and on decrease in load bring the speed to normal within five seconds.

The 15 main generators are located directly above the turbines and are spaced along the generator room 48 feet apart. Two auxiliary generators are equipped with direct-connected exciters mounted on top of the units, while the individual exciters for the main generators are motor-driven, the sets being installed in compartments on the same level as the gatehouse floor, 8 feet above the generator room. These exciter compartments are entirely open toward the generator room, and openings are further provided in the partitions between the compartments, thus affording a continuous passage through the whole length of the exciter gallery. The auxiliary exciter, lighting and power transformers, as well as the auxiliary switchboards, are all located in compartments on this gallery, facing the generator room.

The large main transformers are installed on the same floor level and back of the exciter sets, in compartments opening toward the gatehouse. The low-tension busbars and oil switches are located above these compartments.

The high-tension room occupies almost the entire top floor of the gateroom section of the building, at the same elevation as the roof of the generator room, and divided into a number of compartments, or, rather, rooms, for separating the various high-tension switches, lightning arresters, connections, etc. The outgoing lines run through bushings to the roof structure, to which the long river spans are anchored. These roof structures also support the line-disconnecting switches and the lightning-arrester horn gaps, while the arrester tanks are installed on the high-tension switch-room floor.

The control switchboards are located in a large room at the south end of the high-tension switch-room floor, entirely shut off from the generator room; but, by descending a short flight of stairs to an inspection gallery, a view of the entire generator floor is obtained. All the pumps for water, vacuum, and air-compressor systems are located in the tunnel below the transformers.

The present installation comprises the 15 main units of the 3-phase, 25-cycle, vertical revolving-field type, having 52 poles and operating at a normal speed of 57.7 revolutions per minute. They have a maximum continuous rating of 9,000 kilovolt-amperes, at 11,000 volts, and when operating at 80 per cent power-factor the temperature rise will not exceed 50 degrees Centigrade on the armature winding measured by resistance or temperature coils placed in the armature slots between the top and bottom coils, 50 degrees Centigrade on the field winding measured by resistance, or 50 degrees Centigrade on all other parts measured by thermometer. The machines are designed for a high internal reactance, limiting the instantaneous short-circuit current to about five times the normal value. At the same time they have an inherent regulation of approximately 8 per cent at unity power factor and 20 per cent at 80 per cent power factor.

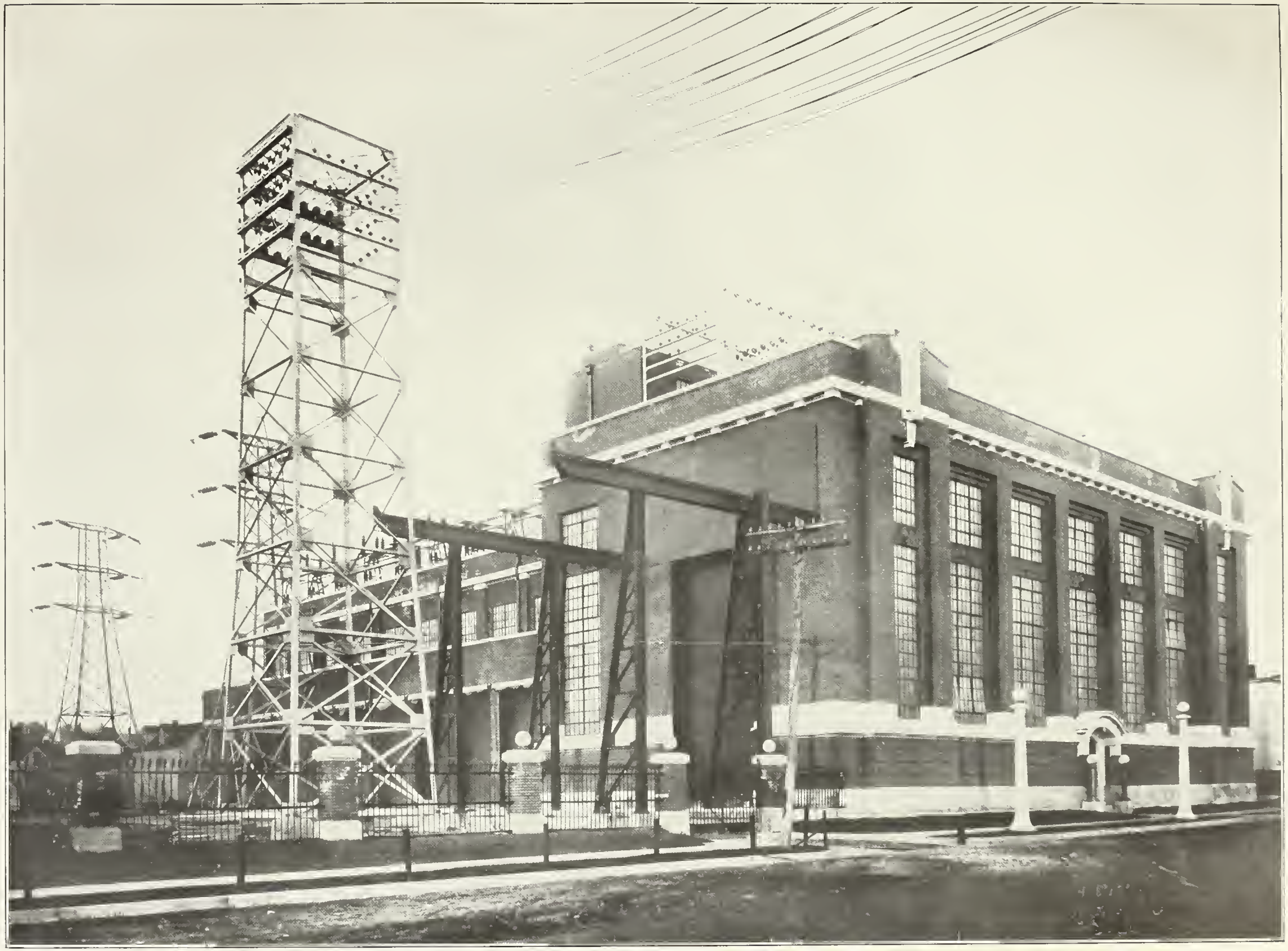
The system of excitation is of unusual interest. In order to obtain the greatest flexibility, each generating unit is provided with a separate exciter. These are motor-driven and operate at a much higher speed than would have been possible with direct-connected units. The exciter sets receive their driving power normally from an entirely independent source, consisting of two auxiliary water-wheel driven alternators feeding into a set of busbars which run the full length of the station; sectionalizing switches being provided only in the middle so that if desired the bus can be divided into two sections with one auxiliary alternator connected to each. The exciter sets can also be fed from the main bus, four step-down transformers being provided for this purpose. They connect the main bus with a second auxiliary exciter bus, sectionalized in four groups with one transformer for each group. Connections can also be established, in case of emergency, with one of the duplicate storage batteries used ordinarily for the operation of the oil switches.

The two auxiliary alternators are equipped with individual direct-connected exciters, and regulators serve to keep the auxiliary bus voltage constant. Besides supplying the exciter sets, energy is also normally taken from this bus for the power and lighting of the station.

The field current is conducted directly from the motor-driven exciters to their respective generators, the commutator brushes of the former simply being connected to the collector ring brushes of the latter, with solenoid-operated field switches inserted in one of the leads. The regulation is accomplished by adjusting the fields of the individual exciters, thus eliminating large field rheostats and energy losses in the main field circuits. Each exciter is provided with its own regulator, and parallel operation with compensation for cross currents is obtained by means of current and potential transformers which are installed in the generator leads and connected 90 degrees out of phase with each other.

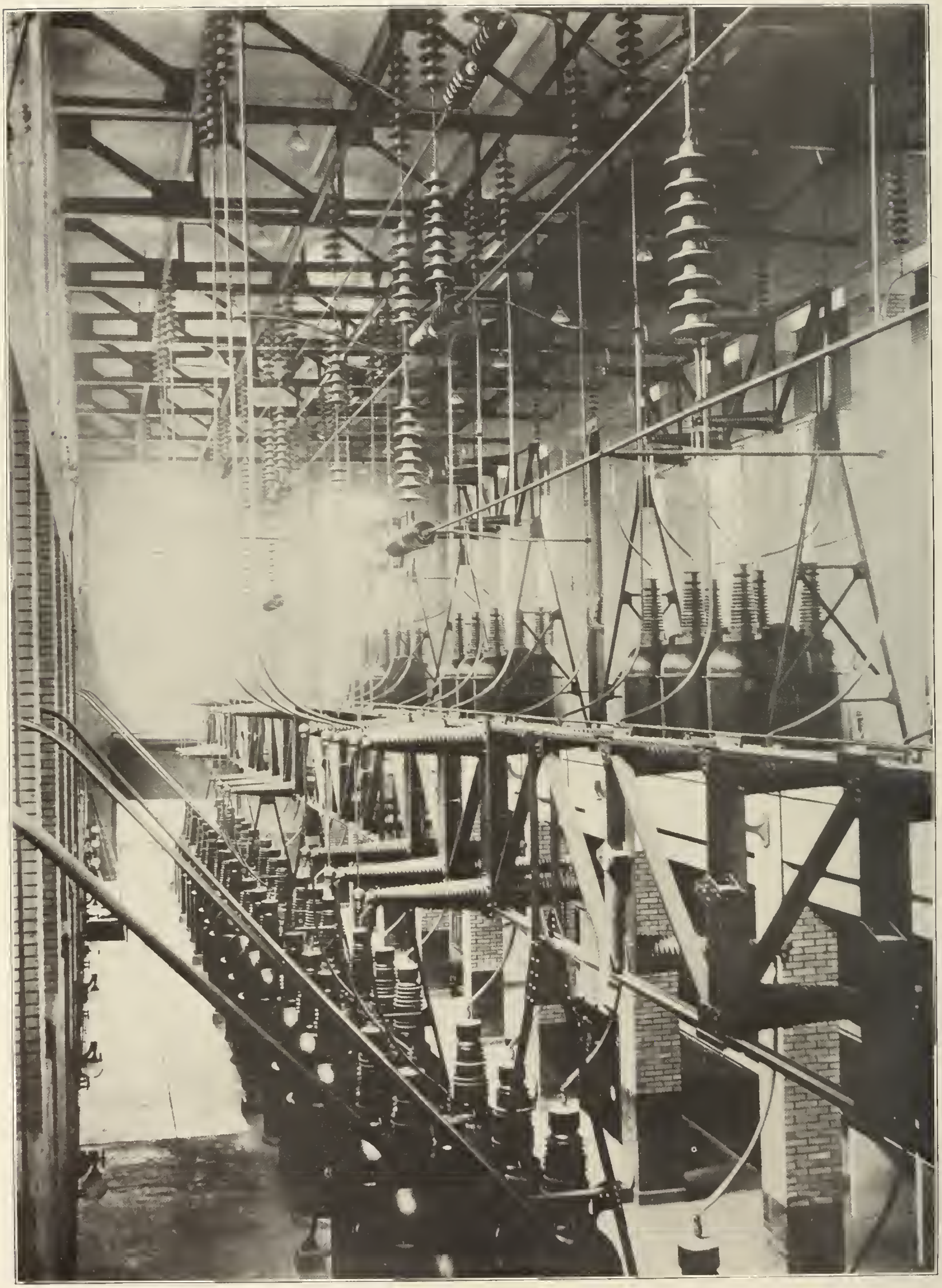
The two auxiliary alternators are of the vertical type direct connected to water wheels. They have a maximum continuous rating of 2,000 kilovolt amperes at 460 volts and operate normally at 125 revolutions per minute. Their general design is the same as that of the main units, with the exception that each is equipped with a direct-connected exciter mounted on the upper bearing bracket so that the machines can be started as self-contained units. The upper bearing bracket also supports a roller thrust bearing which carries the weight of the total revolving element, including the water-wheel runner and the water thrust.

There are nine main 3-phase oil-insulated water-cooled transformers of the shell-type construction, with a maximum continuous rating of 9,000 kilovolt amperes and a temperature rise not exceeding 50 degrees Centigrade based on an ingoing water quantity of 46 gallons per minute at a temperature of 27 degrees Centigrade. The low-tension, 11,000-volt winding is delta connected, and the high-tension 110,000-volt winding Y connected. The high-voltage winding is very heavily insulated and has been submitted to a one-minute high-potential test of 250,000 volts from primary to secondary and core, and across the full winding, while the high-tension bushings have



ST. LOUIS SUBSTATION, ELECTRIC COMPANY OF MISSOURI—ELECTRIC CURRENT GENERATED BY THE MISSISSIPPI RIVER POWER CO. AT KEOKUK, IOWA.

(Face p. 126.)



HIGH TENSION SWITCHING EQUIPMENT, ST. LOUIS SUBSTATION, ELECTRIC COMPANY OF MISSOURI.

been tested at 450,000 volts. The efficiency of the transformers at normal load is approximately 98.5 per cent; the regulation at unity power factor is 1.3 per cent, and the reactance 5.7 per cent. The supporting framework, which holds the core and coils together, is built of structural I-beams, channels, and angles. The tanks are made of boiler plate reinforced by numerous ribs and designed to withstand atmospheric pressure. The top covers are provided with gaskets, making the transformers practically air-tight. However, a 4-inch overflow pipe is provided and sealed with oil-paper gaskets. The cover, core, and leads can be lifted out of the tanks without detaching any parts, while the whole unit rests on a wheeled truck which permits moving the transformer from its compartment out into the gatehouse where it may be handled by the crane.

The cooling coils are of 1½-inch wrought-iron pipe, each coil being made up in three sections, the total length being 1,834 feet. They are designed to withstand a water pressure of 500 pounds per square inch. The water for cooling purposes is pumped from the gatehouse by motor-driven centrifugal pumps, after which it is filtered and led to the cooling coils. A duplicate system of piping is provided, the valves and visible discharge nozzles being mounted back of the transformer compartments on the walls facing the generator room.

Each transformer requires about 10,000 gallons of insulating oil, and a complete piping system with pumping equipments has been installed for handling this between the cars, tanks, and the various transformers. Large storage tanks for both filtered and unfiltered oil are installed in separate compartments in the lower tunnel below high tailrace water level, the tanks being embedded in sand as a fire protection. Each transformer occupies a floor space of approximately 9 feet by 16 feet. The height to the top of the cover is 18 feet 6 inches, and to the top of the high-tension leads 24 feet 3 inches. The weight of the complete transformer units, including the oil, is 246,000 pounds.

The contract entered into to supply 60,000 horsepower of electric energy to the public utilities of St. Louis is very elaborate. The base rate made is $18 a horsepower year at 60 per cent load factor. However, by an interesting provision, it is agreed that there shall be a revaluation every 10 years, made by arbitrators, if necessary, to fix anew the rate for electrical energy according to the fluctuation in the market price for coal as determined by taking the average for a term of two years before the date of revaluation. The base rate for coal is taken as $1.42 a ton. For each increase or decrease of 1 cent in the price of coal a corresponding increase or decrease of one-half of 1 per cent shall be made in the price of the hydroelectric energy. Thus, if in 10 years the price of coal has gone up 20 cents a ton, the price of the energy delivered in St. Louis will be advanced 10 per cent, making it at that time $19.80 a horsepower year. Similarly, a reduction in the price of coal will mean a reduction in the price of electricity under the St. Louis contract, which is for a term of 99 years.

Other low heads.—The report of 1905 described a plant of 21 feet head belonging to the Indiana and Michigan Electric Co. on the St. Joseph River, Michigan. On the same river the same company has obtained 2,000 horsepower from a 10-foot-fall plant near Buchanan. The concrete dam has a spillway 396 feet in length, its sill creating a head of 10 feet above the tailrace. The generating plant is housed in a brick structure 272 feet long on a massive concrete foundation forming part of the dam.

In October, 1911, an interesting plant was put in operation under an 11-foot head at Marseilles, Ill., supplying energy to half a dozen lighting systems as well as to 125 miles of interurban railway. The Marseilles plant utilizes water from the Illinois River, which was first dammed at that point some 40 years ago. Power is still supplied to local industries from the fall thus made available and also to this new plant. The difficulties in utilizing so low a head for hydroelectric work are the very low speed of the wheels, if the individual wheels are to be of any considerable power, and the regulation, which becomes increasingly difficult as the head falls. There is also very frequently extreme trouble from "drowning out" the wheels during times of flood, and extraordinary means have often to be taken to secure anything like uniform speed of the wheels on account of the variable head. In this particular instance the trouble from variable head was less than would be found in many comparable plants. With only 11-foot head available, large horizontal turbines were practically out of the question. It has been not unusual in such cases to install several turbines with vertical shafts connected by beveled gears to a common driving shaft by which, either directly or indirectly, the generator is driven. In this way it becomes possible to combine several fairly high-speed wheels on a single generator which can then be of normal construction and speed. The objections to this plan are the loss of efficiency in the gearing and the amount of space taken. Such construction calls for costly mechanical equipment and a loss of energy in the gears greater than would ordinarily be found in a change of the design in the dynamo to adapt it to lower speed. European practice has gradually drifted away from this construction for hydroelectric work toward the use of special very low-speed generators, direct-connected to the water wheel on the vertical shaft. In the Marseilles power house this later plan of operation has been adopted with admirable results. The old hydraulic equipment did not lend itself readily to this arrangement and there was installed in the new power house along the old lines, three 62-inch turbines being geared to a common horizontal shaft driving a single generator, in such groups as fully to utilize the old equipment. The later units are of 320 kilovolt-amperes each. The generators are of a typical umbrella type, each directly driven from a 74-inch vertical-shaft turbine at 75 revolutions per minute. One specially interesting feature of the equipment is the means taken to support the weight of the revolving parts, necessarily considerable, since in addition to the runner of the turbine the rotor of the generator is some 10 feet in diameter. The low head and considerable weight were unfavorable to the use of the ordinary water-step support, and in this case the entire weight of the revolving parts is taken on a roller bearing, oil-lubricated, at the top of the umbrella. In other words, the rotor and the runner are hung from a thrust bearing at the top of the unit, where they can be inspected with the greatest readiness. The arrangement is such that the rotor and, if necessary, the runner can be easily lifted out by the traveling crane. Each individual turbine is controlled by a quick-acting governor, operated by pressure oil and controlled by a push-button switch on the main board, so that the speed of the machines can be very easily adjusted for the purpose of synchronizing.

A plant with 13-foot head was started in July, 1910, in north-central Kansas by the Rocky Ford Milling & Power Co., securing 800 kilowatts in capacity from 3-cycle, 60-volt generators, delivered into the city of Manhattan, 3 miles away, at a pressure of 6,600 volts to a local distributor, the Manhattan Light, Ice & Power Co., which maintains its steam plant as a stand-by. The generating company does not sell its energy outright to the distributing company, but accepts as its payment a fixed proportion of the amount paid by the consumer at his prevailing rate. By this arrangement the distributor pays all the charges for getting the current delivered to the retail purchaser, as well as for selling, metering, billing, and other local expenses.

Water power development in Atlantic seaboard and East South Central states.—In the Atlantic seaboard states the medium water-power heads have found their development, while on the Pacific slope extremely high heads are not uncommon. The census period has witnessed several important developments both in New England and south of the national capital. In New England the conspicuous example is the Connecticut River Transmission Co., which, beginning a few years ago with a plant on the river at Vernon, Vt., of 20,000 horsepower, has grown into a large enterprise, reaching through its circuits such cities as Fitchburg, Clinton, and Worcester, Mass., and Providence, R. I., with energy developed at a series of plants all capable of feeding into the common transmission network, in which the line pressure runs up to 120,000 volts.

The Southern Power Co. has long been a leader in electrical power development and transmission, and its work has been instrumental not only in stimulating a great variety of industries in North and South Carolina, but in setting an example to other sections of the country. This company now has operating voltages of 100,000 and transmits energy to a distance of 210 miles, a range exceeded slightly at probably only one or two other points within the United States, and nowhere else in the world.

An interesting southern plant which went into operation during 1911–12 is the third installation of the North Carolina Electrical Power Co., of Asheville, N. C., on the French Broad River, 25 miles northwest of that city, in the mountains. The normal rating of the plant is 5,000 horsepower, and it represents in round figures an expenditure of $500,000, or $100 per horsepower. To make a suitable site it was necessary to raise and rebuild 2.5 miles of the track of the Southern Railway, which skirts the river at this point. The track at the dam was raised 20 feet higher than the old roadbed, the total excavation amounting to about 60,000 cubic yards, 80 per cent of which was of solid granite. The change in roadbed alone cost $75,000 and required one year to complete. All of the relocation work was done without interference with traffic, although there were operated over this line an average of from 30 to 40 trains per day. The dam is 530 feet long, 30 feet high, 43.75 feet thick at the base and 11 feet at the top. It is built of very heavy concrete, the large stones in some instances representing 5 cubic yards. The downstream face of the dam is curved in such a manner as to insure that the water will always cling to the surface and prevent the formation of a vacuum under the falling sheet. In the dam, next to the power house, are two circular mud gates, 7 feet in diameter, which are opened and closed by an electrically driven pump in the power house. The gates and cylinders are entirely submerged. The four penstock gates are among the largest cast-iron gates made; each gate covers a clear opening of 18 feet by 7.25 feet, and weighs 13 tons; and they are operated in pairs by an electric motor. There are two 1,875-kilowatt, 3-phase units, 60-cycle, 6,600 volts, with vertical shafts, the exciters being on top of the alternators. For transmission the electromotive force is stepped up to 66,000 volts. Duplicate transmission lines have been built on private right of way, one on the west side and the other on the east side of the river, to Plant No. 2, 6 miles northwest of Asheville, where there is a substation for distributing energy to Asheville, Canton, and other places. The other two hydroelectric plants owned by the company develop 4,000 horsepower, all of which has been utilized in Asheville.

One of the most notable of the recent hydroelectric developments in the South is that of the Ocmulgee River by the Central Georgia Power Co., at Lloyds Shoals, Ga., midway between the cities of Atlanta and Macon, where four streams, the South, Yellow, Alcovy, and Tussahaw Rivers, unite the liquid resources of a huge watershed and afford an unusually vast reservoir capacity. The reservoir itself has an area of some

4,000 acres, estimated to contain at least 3,000,000,000 cubic feet of water, and the water has been backed up by its creation for a distance of 15 miles. The dam is 11 feet wide at the crest, 95 feet wide at the base, and 1,710 feet between the abutments. It is erected between two high bluffs, which with the river bed are of solid gray granite. The power house, integral with the dam, is 200 feet long, while the spillway occupies 728 feet. The power house is a brick and steel structure, designed for six main generator units of 3,000 kilowatts, at 60 cycles. The voltage of 2,300 is stepped up to 63,000 for the long-distance transmission service over 41 miles to Forsyth and Macon on the south and 18 miles to Griffin on the north. Steel-tower transmission lines are used, the towers being on an average 500 feet apart. The right of way, which is owned by the company, is 100 feet wide and entirely cleared of standing timber. The Central Georgia Co. is a wholesaler, delivering to customers in a field where there is widely diversified industry requiring energy in considerable blocks, for cotton mills, cottonseed-oil mills, breweries, flour mills, fertilizer factories, packing plants, brick fields, knitting mills, railway plants, etc.

Another notable southern installation of the period is the 27,000-horsepower hydroelectric plant of the Eastern Tennessee Power Co. on the Ocoee River at Parksville, Tenn. The dam, built of concrete, is 840 feet long at the crest and is from 115 to 125 feet thick at the base, with a spillway 362 feet in length. The water enters the penstocks at a point about 30 feet below the crest. The main building of the power house, 165 feet long and 35 feet wide, situated immediately below the dam, of which its superstructure is an integral part, contains five main generating units, each rated at 5,400 horsepower when operating under 98 feet head at 360 revolutions per minute. The energy is generated at 2,300 volts, the electromotive force being raised to 66,000 volts by transformers housed in a wing at the north of the main building. In addition to the 27,000 horsepower available from this plant, provision for a secondary development of 11,000 horsepower at Parksville has been made by building two openings in the dam, to which penstocks leading to a power station about 400 feet below the dam will be attached. The energy available from this source will be used as a reserve to the main plant. Besides these plants, a second development of 20,000 horsepower has been under construction on the Ocoee River, the available water-power resources of which aggregate 75,000 horsepower. Energy is transmitted at 66,000 volts over two 3-phase circuits to Cleveland, Tenn., a distance of 13 miles from the plant; and from the switching station in Cleveland, where the lines separate, the energy is carried over single-circuit wood-pole lines 26 miles west to Chattanooga, Tenn., 85 miles northeast to Knoxville, Tenn., and 75 miles south to Rome, Ga.

High-head water-power plants.—Examples of low-head and medium-head hydroelectric plants are found chiefly in the Central, Eastern, and Southern states, and it is to the Pacific slope that one looks for the high-head systems and the more spectacular instances of power transmission. One such system is that of the Arizona Power Co., which has no great river flow to depend upon, but uses water direct from springs. Such a plant is quite exceptional. The source of power is the overflow from springs at Fossil Creek, which pour from unknown subterranean depths in Gila County, Ariz. These springs are heavily mineralized, so that the deposit from them coats the surroundings in a way that suggested the name. On investigation they proved to yield a flow which, except when temporarily swollen by one of the rare rainfalls of the region, remains absolutely constant year in and year out at 43 cubic feet per second. This is not a large quantity, but, backed by a drop of 1,600 feet, it makes a power with large possibilities. In the present development the whole of the head has not been utilized, since by employing the lower 1,100 feet it was feasible to utilize a small basin having an area of about 28 acres as a storage reservoir. Under this plan the power-house site, which, while, hydraulically speaking, upon Fossil Creek, is actually on the Verde River at a point where it is more convenient to drop the water into the river than at the actual confluence of Fossil Creek with the Verde. To the west and southwest, at a distance of 50 or 60 miles, are Prescott, Ariz., and an important mining district eager for cheap power. To get the water from the head works to the power house involved covering a distance of 38,000 feet, of which 12,000 feet is in reinforced concrete flume, 11,000 feet of concrete tunnels, 7,500 feet of steel gravity siphon (part of it on four long steel bridges) and 2,200 feet of wooden flume on trestles, the remainder being of reinforced concrete and steel piping, taking up the pitch downward to the power house. The power house itself contains three 1,800-kilowatt generating units with the customary electrical equipment for a line pressure of 45,000 volts, which is carried over 75 miles of steel-tower transmission line. One of the interesting features of the plant is the use of a large amount of reinforced concrete flume, to which the constructors were driven by the rocky nature of the ground. The smoothness of the flume is a very material advantage, particularly where the flow is rapid, inasmuch as the coefficient of friction is reported to be a good deal less than for ordinary ditches or the wooden flumes so extensively used on the Pacific coast. The storage reservoir is a very important feature of the undertaking. It is 5 miles from the head works and on the line of the concrete flume, and can be drawn off at an average depth of 10 feet over 28 acres, yielding sufficient capacity to run the entire plant for 3½ days at the average steady flow of the stream. Below the lake, 5,600 feet of the hydraulic way next to it is a concrete-lined tunnel through the mountain, and the rest is reinforced concrete and steel pipe. The power house is installed with three 1,800-kilowatt generating units each driven by a 3,000-horsepower impulse water wheel, and the arrangement of the station is exactly as if three stations, each of one unit, were independently located at different points along the transmission line. The wheels have needle-valve regulation. The only switches are those on the high-tension side of the transformers. For purposes of distribution the line voltage is reduced to 11,000 volts in the substations, and energy is delivered to customers at 400 volts, 60-cycle, 3-phase. One mining company alone takes 2,000 horsepower.

Another unusual western plant, though not one of extremely high head, was put into commission in 1912, utilizing a head of 181 feet from the Thousand Springs, rising from lava beds in Idaho. Practically the whole state of Idaho and parts of Utah and Nevada are overlaid with a great lava sheet which covers the sedimentary rock, in some places to a depth of several hundred feet. This lava rock, now hardened and more or less impervious to water, lies on a sandstone equally impervious. But in the plane of contact between these two formations, underground streams are collected and flow for miles without meeting the light of day. In southwestern Idaho, where the Snake River has cut its channel more than 300 feet deep through the 100-foot surface layer of igneous lava, and then through the softer sedimentary rocks for 200 feet or more, egress is afforded for one of these underground rivers in a curious way. For a distance of nearly half a mile along the side of the canyon the water pours out into view from the plane of the lava contact, forming the famous Thousand Springs. The source of the water itself is unknown and certainly is not within 100 miles of the point where it emerges from its underground channel. The stream has an average flow of about 750 cubic feet per second and is very uniform in character, varying little during the seasons of the year. From the level where it emerges, 100 feet below the top of the canyon, a head of 181 feet is available down to the Snake River, which flows below, and here a 3,000-horsepower water-power plant has been constructed, with provision for extensions to 12,000 horsepower to utilize the full flow of the springs. Many different attempts have been made in earlier years to collect and utilize the flow from the Thousand Springs, but without success, owing to the peculiar nature of the problem, the difficulty of foundationing structures on the side of the cliff, and the long contact outlet of the water. The solution of the problem was the erection of a concrete canal wall on the side of the cliff at the outflow level. This wall is 400 feet long and in places 16 feet high. It forms a canal 20 feet wide, whose other side is the native cliff, and in which the water from the numerous spring outlets is collected. At one end for a distance of 150 feet the canal is widened out to 40 feet, forming a forebay opening to the penstocks which lead to the power house, nearly 200 feet below. The Thousand Springs development is capable of furnishing 12,000 horsepower. The initial machinery consists of two 1,500-horsepower units, spiral scroll-case water wheels, operating under the head of 181 feet, driving 2,300-volt, 60-cycle, 3-phase alternators. No gate valves are provided for the penstock tubes, but quick-closing head gates are inserted at the tops of the pipes. These head gates are hoisted by worm-geared motors, although it is possible to close them almost instantaneously from the power-house floor, by means of a tripping rope allowing them to fall and shut. From the alternators the electromotive force of the 2,300-volt, 60-cycle energy is stepped up to 40,000 volts for transmission to Idaho points, where the energy is chiefly used for irrigation pumping. The hydroelectric site is 8 miles south of Windell, Idaho, on the Snake River.

The "tying in" of hydroelectric plants with irrigation systems is also one of the newer and interesting features of work in the far West and on the Pacific coast. One example may suffice. For a number of years the Davis & Weber Counties Canal Co. has operated an extensive irrigation system supplying a large district near Ogden, Utah. By means of a canal extending far up the famous Weber Canyon and paralleling the Union Pacific Railroad's right of way, water is diverted from the Weber River and led out through a concreted channel, which for miles skirts the foothills and marginal slopes of the lower river, supplying water to the farms below and beyond. Realizing the water-power possibilities of the original irrigation system, it was found feasible to develop over 13,000 horsepower with the 200-foot head available between the canal and the river. Of this total capacity, an initial installation of 3,750 horsepower has now been completed. At the point selected as the most advantageous for this development the river flows on the far side of an old broad flood-plain (now rich farm land), bringing the natural discharge channel more than half a mile from the hillside canal. The water-power plant was accordingly located at about the midpoint of this 2,800-foot distance, being supplied through steel penstocks 1,400 feet in length, while a tailpiece of about the same length had to be excavated to connect the turbine shaft tubes with the river. In many respects the Riverdale plant is therefore unique, having huge steel penstocks of extraordinary length under full hydraulic head, and special features of design to control and withstand the remarkable normal and impact forces involved in these great moving masses of water. Utilizing its own available resources to the limit, the plant also "borrows" the flow of an independent irrigation ditch, later returning it to the lower channel by means of a centrifugal pump after extracting the net energy of nearly 200 feet of fall, which would otherwise be wasted. In spite of the difficult natural conditions to be overcome, and the completeness and excellence of its equipment, the plant has been erected at a very low cost, said to have been less than $45 per kilowatt.

The point of diversion of the main irrigation-ditch supply is in the Weber Canyon, 8 miles from the power house. The 30-foot channel has been concreted, rendering it waterproof and permitting higher velocities of stream flow without danger of "washing" the sides. Originally 325 cubic feet per second was the water allowance granted the irrigation company, but this quantity has since been augmented by additional fillings of 300 cubic feet per second. These amounts do not include, however, the 18 cubic feet per second obtained from the Riverdale ditch, which passes the plant. From September 15 to April 15, 643 cubic feet per second is thus available for waterpower use. During the remaining months of the year, which constitutes the irrigation season, only 318 cubic feet can be taken.

The initial installation comprised two principal water-wheel units, one of 2,500-kilowatt and the other of 1,250-kilowatt rating. Each is separately supplied from the gatehouse through its own steel tube, 1,400 feet in length. To form the forebay, the 30-foot concrete-lined canal on the side of the hill has been widened to 60 feet for a distance of 250 feet, providing a basin which is in part closed on the plant side by the gatehouse. This concrete and brick structure provides four penstock openings, including two other outlets for additional 2,500-kilowatt units in the future. Trash racks protect the intakes of the present penstocks, which can be closed, respectively, by 96-inch and 72-inch sluice gates, operated by 3-horsepower induction motors. These gates work under 19-foot head and can be manipulated from the power house or from the gatehouse itself, as desired. In the first 400 feet the penstock tubes drop 173 feet, reaching the flood-plain surface, on which they are carried, practically level, for nearly 1,000 feet to the power house.

Perhaps the most spectacular work embraced within the present census period, and fitly closing it, is that of the Big Creek development in central California carried out by the Pacific Light & Power Corporation. In addition to involving the highest voltage for transmission over the longest distance yet attempted, the installation possesses many features of interest from the purely hydraulic standpoint. It is 175 miles from San Francisco and 240 miles from Los Angeles, and the elevation is about 7,000 feet. In the total installation a fall of 4,000 feet will be utilized to generate 120,000 kilowatts for the system of the Pacific Light & Power Corporation, which already has an aggregate equipment rating of 70,000 kilovolt-amperes in six hydroelectric and three steam plants, and serves a population of 400,000 in Los Angeles and surrounding cities, including Pasadena, Riverside, and San Bernardino. The scheme involves the construction of two power houses, each with an ultimate equipment of 60,000 horsepower in four wheels, of which two are installed initially; and the plants can be operated independently. The generating units are 3-phase, 6,600-volt machines driven by two overhung impulse wheels on the same shaft. The combined rating of the two wheels of each unit is 20,000 horsepower. The current is to be stepped up to 150,000 volts for the line of 240 miles, which will consist of a double set of steel towers, each supporting three steel-cored aluminum conductors arranged horizontally. The line stands largely on a private right of way, and the plant is located in the Sierra National Forest, about 70 miles west of Fresno, the permit granted by the United States Department of Agriculture being the most important thus far issued.

The annual rainfall of the Big Creek watershed is more than 80 inches for an average year, and the run-off is equivalent to at least 50 inches. Three gravity-section concrete dams, two 100 feet and the third 164 feet in height, close all the natural openings in the basin. These dams are built upon solid granite formation, the construction material, with the exception of the cement, being available close at hand. Upon leaving the basin, Big Creek drops about 4,000 feet within a distance of 6 miles. With such a great difference in elevation, and with a reservoir to equalize the flow of the stream, a comparatively small amount of water is necessary for hydroelectric development. If there were no inflow for five months, it would probably be possible to operate during that period on storage alone, assuming a 50 per cent load factor. From the reservoir the water is led southwest through a 4,000-foot tunnel cut in solid granite to a steel flow pipe, which continues 6,800 feet along the surface to the mountainside above Big Creek. Here the water enters pressure pipes and drops about 2,100 feet through the wheels of power house No. 1 to the forebay of a second tunnel formed by a dam 70 feet in height, built across the bed of the creek. Tunnel No. 2 carries the water through solid granite to the crest of the gorge, about 4 miles southwest of power house No. 1. From the outlet of this tunnel the water enters pressure pipes and falls about 1,900 feet to power house No. 2. It will be possible to generate about the same power at each of the plants, as the forebay of the second tunnel is located at a point just below the juncture of Pitman and Big creeks, and the additional supply of water increases the power available at station No. 2 and in a measure compensates for the difference in static heads at the two plants. On November 8, 1913, the plant went into operation, transmitting 18,000 horsepower to Los Angeles at a pressure of 135,000 volts.

The Southern Sierras Power Co., a subsidiary company of the Nevada-California Power Co., of Denver, Colo., completed in 1912 a double, 3-phase, high-tension, steel-tower transmission line northward from its San Bernardino, Cal., plant, through the Owens River Valley for a distance of 236 miles to Bishop, Inyo County, where the company has two hydroelectric developments with an aggregate rating of 4,000 horsepower. The Southern Sierras Power Co. owns and operates a 5,000-horsepower steam turbo-generating and distributing system at San Bernardino, the distributing system at Corona, Cal., and also an 80-mile distributing system covering the San Bernardino, Riverside, Corona, San Jacinto, and Perris Valley districts, embracing a thickly settled territory of at least 50,000 population. The hydroelectric stations are on Bishop Creek, a tributary of the Owens River. One of the stations, which is already in operation, has a rating of 2,000 horsepower, while another of the same rating has recently been constructed.

At Long Lake, west of Spokane (Wash.), there has been under construction a new plant for the Washington Water Power Co., with the highest spillway dam in the world. It is 200 feet in total height, a fall of 170 feet has been created, and a storage lake 23 miles in length and averaging three-eighths of a mile in width has been made. Considering only 15 feet of storage, the water thus held for reserve amounts to 2,695,000,000 cubic feet, all of which is available not only for the Long Lake plant, but also for the older one at Little Falls. The dam is unique in at least two important particulars. Owing to the topography it has not been considered feasible to provide a spillway for flood waters except over the dam itself. This means that the dam is not only higher than any other spillway dam now in existence, but will at times of flood carry about 10 feet of water over its crest. It has been determined to hold the low-water level of the lake at the same level as at high water. This will be accomplished by the use of three roller dams of German type mounted upon the crest of the spillway, Each roller is 65 feet long and 19 feet deep, and will be operated by suitable power mechanism. The plant will consist of an ultimate installation of four 13,900-kilovolt-ampere generators having a continuous overload capacity of 25 per cent, each generator being connected to a water wheel rated at 22,500 horsepower. These are the largest water wheels ever built. The Washington Water Power Co., for which this new plant is needed, supplies electrical energy to Spokane, Wash., as well as to all the towns and cities in the Inland Empire within a territory extending approximately 100 miles west, north, and south of that city. It has 534 miles of 60,000-volt transmission line, two sections of which feed the Coeur d'Alene mining district in Idaho, the largest producing lead-mining center in the world. From Spokane to Wallace, Idaho, two independent lines traversing different routes carry the electrical energy to the center of the extensive lead-mining district, nearly 100 miles east of its point of generation. Another high-tension line extends south for nearly 65 miles into the fruit-raising Palouse country, one of the great wheat belts of the Northwest. From this line the towns along the route are lighted, flour mills are operated, and electricity is distributed for general use. Still another line extends 117 miles into the Big Bend country contiguous to the Columbia River, a rich fruit-growing and wheat-raising addition to the older Palouse country. The line to the north extends as far as Newport in the lumber region, traversing also a part of the state of Idaho. In Spokane the energy is distributed for the operation of over 24 miles of interurban electric railways and 88 miles of city lines, the company's two interurban lines connecting Spokane with Cheney and Medical Lake. The Great Northern Railroad shops are among the many industrial establishments supplied in Spokane from its circuits. The system generates a large part of its energy from water power at the very heart of the city, and has other sources of supply, as at Post Falls, Idaho, and more recently at Little Falls, Wash., 30 miles west of Spokane, with 20,500-kilowatt capacity.

Attention may be called to the automatic pumping station at the Mill Creek, Utah, plant of the Knight Consolidated Power Co., a singularly clever and ingenious method of conserving water supply in a territory where water is precious and the available amount is limited. This plant, working on the somewhat scant and variable supply of a mountain stream, fortunately rendering available a head of over 1,000 feet, at certain seasons of the year found itself painfully short of water. Had there been a second stream available, it would have paid to go to considerable expense to add its flow to that of the primary source of power. This has often been done to meet the exigencies of increasing load and stationary water supply. In this case no such auxiliary stream was available at or near the level of the main supply. A group of springs, however, at a lower level gave hope of additional water in useful quantity, and the bold expedient was adopted of pumping this supply to the level of the main headworks by electric power. A cubic foot of water which one can drop more than 1,000 feet onto the wheels below by pumping it less than 150 feet is not a source of energy to be held in contempt. The project as actually carried out involves an automatic pumping station driven by an induction motor coupled directly to a centrifugal pump capable of delivering 3.5 cubic feet of water per second against a head of 138 feet. The little pumping plant requires no attention. The result is very interesting. Except in May and June, when the primary water supply outruns the capacity of the pipe line, it pays to pump the spring water. At normal load it takes 67 kilowatts to deliver the 3.5 cubic feet per second at the upper level, and this quantity of water represents 237 kilowatts at the generators below. There is therefore

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ABBREVIATIONS (OTHER THAN FOR MANUFACTURERS AND SYMBOLS).

Al.—Aluminum.
B. & S.—Brown & Sharpe wire gauge.
Circ. M.—Circular mil (a circle 1/1000 inch in diameter).
Cu.—Copper.
D.—Direct.
Hor.—Horizontal.
Hyd.—Hydraulic.
R. or Res.—Resistance.
S. P.—Steel poles.
S. T.—Steel towers.
Sq. In.—Square inches.
Susp.—Suspension.
Vert.—Vertical.
W. P.—Wood poles.
△—Triangular arrangement of conductors.
△—Mesh grouping. The three phases joined up as an equilateral triangle.
Y—Star grouping. The three phases united at a common junction.

TRANSMISSION SYSTEMS OF THE WORLD OPERATING AT AND ABOVE 70,000 VOLTS, RANKED ACCORDING TO OPERATING VOLTAGE.

[Compiled by Sellie Haar as supplement to *Electrical World* April [illegible], 1914, and revised and brought up to date by Mr. [illegible] for Hydro-Electric Section, National Electric Light Association Convention, Philadelphia, Pa., June 2-5, 1914.]

No.	NAME.	Operating voltage.	Frequency, cycles.	Rating of plant, kilowatts: Present.	Rating of plant, kilowatts: Ultimate.	Beginning of operation.	Hydraulic or steam.	Turbines: Horsepower.	Turbines: Head, feet.	Turbines: Revolutions per minute.	Turbines: Shaft horizontal or vertical.	Turbines: Manufacturer.	Generators: Kilovolt-amperes.	Generators: Kilowatts.	Generators: Power factor.	Generators: Voltage.	Generators: Manufacturer.	Step-up transformers: Kilovolt-amperes.	Step-up transformers: Phases.	Step-up transformers: Connection, Low tension.	Step-up transformers: Connection, High tension.	Step-up transformers: Connection Y, grounded direct or with resistance.	Step-up transformers: Total kilovolt-amperes connected to transmission lines.	Step-up transformers: Manufacturer.	Step-down transformers: Line voltage, Low tension.	Step-down transformers: Line voltage, High tension.	Step-down transformers: Connection, Low tension.	Step-down transformers: Connection, High tension.
1	Pacific Light & Power	150,000	50	59,500	300,000	1913	Hyd.	[illegible]	1,750 1,900	[illegible]	Hor.	Al.-Ch.	7,500	14,875	.85	6,600	W. G. E.	5,833	1	△	Y	D	70,000	W. G. E.	72,000 18,000	150,000	△	[illegible]
2	Au Sable Electric Co	140,000	60	19,000	86,500	1912	Hyd.	3,500 4,100	26 35 40	150 164 180	Hor.	Al.-Ch.	2,700 3,333 3,333	2,000 3,000 3,000	.90	2,300	G. E.	3,000	1	△		No	19,000	G. E.	5,000 22,000 44,000	140,000	△	△
3	Southern Sierras Power Co	140,000	60	5,750	40,000	1913	Hyd.	3,300	514 and 258	300 164	Hor.	Hendy Pelton Doble	2,250 2,000	1,750 1,600	1.	2,300	C. W. Al.-Ch.	750 2,000	1	△	Y	R.	5,250	W.	33,000 to 1,100	138,500 110,000		Y
4	Utah Power & Light Co.	130,000	60	33,000	84,000	1914	Hyd.	16,500 15,000	482 140	514 180	Vert.	I. P. Morris	12,222 11,111	11,000 10,000	.90	6,600	W. G. E.	4,000	1			No	24,000	G. E.	44,000	[illegible]		△
5	Pacific Gas & Electric Co	123,000 to 110,000	60	20,000 to 25,000	142,500	1913	Hyd.	[illegible]	1,375	360	Hor.	Pelton Doble	12,500	10,000	.80	6,600	W.	1,250	1	△	Y	D.	25,500	Al.-Ch.	60,000	100,000	Y	Y
6	West Pennsylvania Traction & Water Power Co	125,000	60	32,000	105,000	1914	Hyd.	12,000	82	114	Vert.	W. S. M.	10,000	8,000	.80	6,600	Al.-Ch.	10,000	3			No	10,000	Al.-Ch.	22,000 6,600	120,000		
7	Tennessee Power Co.	120,000	60	15,000	75,000	1914	Hyd.	10,000	250	360	Hor.	I. P. Morris.	9,375	7,500	.80	6,600	W. G. E.	9,375	3			No	18,750	W. G. E.	11,200	120,000 to 95,000	△	
8	Connecticut River Transmission Co.	120,000	60	14,400	14,400	About 1914	Hyd.	About 3,300	57 to 64	257	Hor.	W. S. M.	2,000	1,600	.80	2,300	G. E.	[illegible]	3	△	Y	D	18,000	G. E.	13,400	110,000	△ & Y	
9	Inawashiro Hydroelectric Power Co (*Japan*)	115,000	50	42,000	73,500	1914	Hyd.	About 10,000	350	375	Hor.	Voith	7,775	7,000	.90	6,600	Dick Kerr	4,400	1	△		No	52,800	W.	11,000	110,000		
10	Au Sable Electric Co	110,000	30	9,000	45,000	1906	Hyd.	14,400	40	225	Hor.	Leffel	3,000	3,000	1.	6,600	W.	3,750	1	△		No	11,250	W.	19,000 7,200			△
11	Hydro-Electric Power Commission of Ontario (*Canada*)	110,000	25	106,800	175,000	1910	Hyd.	12,500 12,500 13,400	175	187½	Hor.	Voith W. S. M.	7,500 8,950 9,700	7,500 8,950 9,700	1.	12,000	W. G. E.	3,500	1	△	Y	R.	42,000	W.	26,400 13,200 6,600	110,000		Y
12	Lauchhammer, A. G. (*Germany*)	110,000	50	15,000	20,000	1911	Steam			1,000	Hor.	A. E. G. M. A. N.	14,300 6,250	10,000 5,000	.70 .80	5,000 5,000	A. E. G. S.-S.	6,250	3	Y	Y	No	20,000	S.-S.	60,000 15,000	[illegible]	Y	Y
13	Georgia Ry. & Power Co.	110,000	60	50,000	63,000	1912	Hyd.	17,000	580	514	Vert.	S. M. Smith	12,500	10,000	.80	6,600	G. E.	3,333	1	△	Y	R.	60,000	G. E.	22,000 11,000	110,000	△	
14	Alabama Power Co.	110,000	60	48,000	300,000	1913	Steam	17,500	68	100	Vert.	I. P. Morris	14,000	12,000	.85	6,600	W.	4,667	1	△	Y	R.	56,000	W.	22,000	110,000	△ & Y	
15	Mississippi River Power Co.	110,000	25	112,500	225,000	1913	Hyd.	10,000	32	57.7	Vert.	I. P. Morris W. S. M.	9,000			11,000	G. E.	9,000	3	△	Y	D	72,000	G. E.	66,000 33,000 13,200	95,000		
16	Lehigh Navigation Electric Co.	110,000	25	33,750	100,000	1914	Steam			1,500	Hor.	G. E.	12,500	11,250	.90	11,000	G. E.	3,350	1	△	Y	R.	30,150	G. E.	12,000	110,000		
17	Cedar Rapids Manufacturing & Power Co. (*Canada*)	110,000	60	90,000	135,000	1914	Hyd.	10,800	30	55.4	Vert.	I. P. Morris W. S. M.	10,000	7,500	.75	6,600	G. E.	4,000 8,000	1	△	△	No	72,000		6,600	110,000		
18	Mexican Northern Power Co. (*Mexico*)	110,000	60	26,000	....	1914	Hyd.	10,000	230	360	Hor.	Esch. W.	7,800	7,650	.85	4,000	G. E.	2,500	1	△	Y	R.	[illegible]	G. E.	15,000	110,000		Y
19	Ebro Irrigation & Power Co. Ltd (*Spain*)	110,000	50	30,000	200,000	1914	Hyd.	14,500	164	250	Vert.	Esch. W.	16,666	10,000	.60	6,600	G. E.	4,444	1	△	△	No	60,000	W.	25,000 6,000	100,000	Y	
20	Chile Exploration Co. (*Chile*)	110,000	50	40,000	160,000	1915	Steam	....		1,500	Hor.	Esch. W.	10,000	10,000	1.	5,000	S.-S.	10,000	3	Y	Y	No	40,000	S.-S.	5,000	About 100,000	Y	Y
21	Sierra Electric Power Co.	110,000	..		22,500	....	Hyd.	......					......					......										
22	Sierra & San Francisco Power Co.	104,000	60	34,000	....	1910	Hyd.	11,750	1,500	400	Hor.	Pelton	8,500	8,500	1.	4,000	G. E.	2,833	1	△	Y	D	26,800	G. E.	11,000	104,000		Y
23	Great Falls Power Co.	102,000	60	21,000	125,000	1910	Hyd.	6,000	105	125	Hor.	S. M. Smith	3,500	3,500	1.	6,600	G. E.	1,200	1	△	△	No	21,600	G. E.	[illegible]	91,800		△
24	Yadkin River Power Co.	100,000	60	24,000	....	1912	Hyd.	5,500 5,300	45	164	Hor.	S. M. Smith	6,000 4,500	4,500 3,500	.75 .78	4,000	G. E.	6,250	3	△	Y	D	37,500	G. E.	60,000	100,000	△	△
25	Colorado Power Co	100,000	60	10,000	10,000	1909	Hyd.	9,000	170	400	Hor.	I. P. Morris	5,000	5,000	1.	4,000	G. E.	3,333	1	△	△	No	15,000	G. E.	6,600	[illegible]	△	△
26	Great Western Power Co.	100,000	60	50,000	100,000	1909	Hyd.	18,500 26,000	450 525	400	Vert.	I. P. Morris	12,500 10,000	10,000 10,000	.80 1.	11,500 11,000	G. E.	10,000	3	△	△	No	50,000	G. E.	11,000	90,000	△	△
27	Southern Power Co.	100,000	60	75,000	.....	1909	Hyd.	5,200	60	225	Hor.	Holyoke Marb. Al.-Ch.	3,000	2,550	.85	2,400	W.	4,000	1	△	Y	R.	24,000	W.	44,000 11,000 2,400	100,000	△	△
28	Shawenegan Water & Power Co. (*Canada*)	100,000	60	45,000	80,000	1911	Hyd.	15,500	145	225	Hor.	I. P. Morris	15,000	12,500	.86	6,600	W.	14,000	3	△	Y	R.	28,000	G. E.	12,800	85,000	△	△
29	Los Angeles Aqueduct	100,000	50	22,500	138,000	1914	Hyd.	14,000	870	200	Hor.	Doble	9,375	7,500	.80	6,600	W.	3,130	1	△	Y	D	28,350	W.	31,000 16,500			Y
30	Tata Hydroelectric Co. (*India*)	100,000	50	32,000	64,000	1914	Hyd.	11,000	1,661 to 1,727	300	Hor.	Esch. W.	10,000	8,000	.80	5,000	S.-S.	3,333	1	△	△	No	40,000	G. E.	6,600	85,000		
31	Pfalzwerke, A. G. (*Germany*)	100,000	50	10,000	50,000	1915	Steam	...		1,500	Hor.	M. A. N.	6,250	5,000	.80	5,000	S.-S.											
32	Societa Italiana di Elettrochimica (*Italy*)	88,000	42	23,280	29,100	1912	Hyd.	8,200	249	420	Hor.	Riva	7,300	5,820	.80	6,000	Brown Boveri	3,000	1	△	Y	No	32,400	Brown Boveri	9,600	72,000		Y
33	Appalachian Power Co.	88,000	60	20,610	75,000	1912	Hyd.	6,000 3,500	51 37	116 97	Vert.	I. P. Morris	4,000 2,300	3,600 2,070	.90	13,200	G. E.	6,000	3	△	△	No	24,000	G. E.	13,200	88,000	△	△
34	Rio Janeiro Tramway, Light & Power Co. (*Brazil*)	88,000	50	48,500	90,000	1913	Hyd.	19,000 8,700	1,017	300	Vert.	Esch. W.	12,500 6,000	10,000 4,800	.80	6,300	W.	4,167 1,700	1	△	△	No	55,000	W.	6,000	80,000	△	△
35	Sao Paulo Electric Co. (*Brazil*)	88,000	60	30,000	50,000	1914	Hyd.	14,500	600	600	Hor.	Voith	12,500	10,000	.80	6,300	W.	3,333	1	△	△	No	30,000	W.	25,000	80,000	Y	△
36	Tasmania Hydroelectric & Metal Co. (*Tasmania*)	88,000	50	....	60,000		Hyd.										W.	1,250	1	△	Y	D	13,500?	W.	6,600	88,000	△	Y
37	Mexican Light & Power Co (*Mexico*)	85,000	50	58,500	100,000	1910	Hyd.	7,000 13,000 to 14,000	1,200 to 1,300	300	Vert.	Esch. W.	7,500 12,500	6,000 11,250	.80 .90	4,000	S.-S. G. E.	2,000 6,000	1	△	Y	D	70,000	G. E.	4,000 210	[illegible]		Y
38	Toronto Power Co (*Canada*)	85,000	25	50,000	95,000	1914	Hyd.	13,000 to 15,000	133 to 135	250	Vert.	Esch. W. I. P. Morris	7,500 10,000	6,000 8,000	.80	12,000	G. E.	2,666 6,000	1 3	△	△ Y	No	51,000	G. E.	12,000	80,000	△	△
39	Victoria Falls & Transvaal Power Co (*South Africa*)	84,000	50	40,667	40,667	1913	Steam	.....		1,000	Hor.	A. E. G.	12,500 18,000	8,333 12,000	.67	5,000	A. E. G.	12,500 8,000	3	△	Y	R.	61,000	S.-S. A. E. G. W.	20,000	About 80,000	Y	△
40	Northern Power Co.	80,000	60	....	....	...	Hyd.	...																W. G. E.	4,400 22,000			
41	Energia Electrica de Cataluna (*Spain*)	80,000	50	Kva. 30,000	Over 100,000	? 1913	Hyd.	....	? 2,6?0				.....												11,000			
42	Katsuragawa Denryoku Kabushiki Kaisha (*Japan*)	77,000	50	22,400	50,900	1912	Hyd.	8,000	470	500	Hor.	Voith	7,000	5,600	.80	11,000	G. E.	3,500	1	△	Y	R.	31,500	G. E.	11,000	70,000	△	Y
43	Southern California Edison Co.	75,000	50	20,000	....	1907	Hyd.	2x5,375	874	250	Hor.	Al.-Ch.	5,000	5,000	1.	2,300	G. E.	4,067	1	△	Y	D.	20,000	G. E.	30,000 15,000 2,300		Y Y	Y
44	Au Sable Electric Co	72,000	30	3,000	3,000	1900	Hyd.	7,000	38	225	Hor.	Leffel	1,500	1,500	1.	6,600 (6,000)?	W.	1,200	1	△	△	No	3,600	W.	6,600	60,000		△
45	City of Milan (*Italy*)	72,000	42	21,000	.....	1910	Hyd.	12,000	1040	315	Hor.	Riva	8,750	7,000	.80	10,000	Brown Boveri	2,850	1	△	Y	R.	25,650	Brown Boveri	8,650	65,000	△	Y
46	Societa Generale Elettrica dell' Adamello (*Italy*)	72,000	42	About 45,000	About 75,000	1910	Hyd.	6,500 5,000	2,985 1,642	420	Hor.	Esch. W. Riva	7,331 5,000	5,500 4,000	.75 .80	13,000 12,000	Brown Boveri A. E. G.	2,700	1	△	△	No	40,500	G. E.	13,000	60,000	Y	Y
47	Montana Co.	70,000	60	21,500	50,000	1901	Hyd.	1,000 4,000	40 65	157 225	Hor.	Day-Sm S. M. Smith	750 2,800	750 2,800	1.	550 2,400	W.	1,250 2,000	1	△	△	No	25,000	W.	2,400	60,000		△
48	Hidroelectrica Espanola Molina (*Spain*)	70,000	50	22,600	22,600	1910	Hyd.	7,200	217	428	Hor.	Voith	6,750	5,400	.80	7,000	S.-S.	6,750	3	Y	Y	No	27,000	S.-S.	5,000	60,000	Y	Y
49	Pennsylvania Water & Power Co.	70,000	25	71,500	Over 100,000	1910	Hyd.	13,500 to 17,000	53 to 63	94 to 116	Vert.	I. P. Morris	7,500 10,000 12,000	7,500 10,000 12,000	1.	11,000	G. E. W.	7,500 10,000	3	△	Y	R.	71,500	G. E. W.	13,000	60,000	Y	△
50	Compania Hidro-Electrica e Irrigadora del Chapala, S. A. (*Mexico*)	70,000	60	8,400	8,400	About 1911	Hyd.	4,100	100	375	Hor.	Esch. W.	3,500	2,800	.80	10,800	S.-S.	4,000	3	Y	Y	No	12,000	S.-S.	20,000 3,000	67,500	Y	Y
51	Societa Elettrica Riviera di Ponente (*Italy*)	70,000	50 16⅔	27,000	60,000	1911	Hyd.	10,000	2,300	500	Hor.	Riva	9,375	7,500	.80	6,000	A. E. G. S.-S.	4,690 3,100	3 1	Y	Y	R.	60,000	A. E. G.	12,000		Y	Y
52	Swedish State Railways (*Sweden*)	70,000	25	17,600	52,800	1915	Hyd.	14,000	164	250	Hor.		11,000	8,800	.80	10,000	All. Sv. El. Akt.	3,670	1	△	Y	D.	11,000		15,000			
53	City of Winnipeg (*Canada*)	66,000 to 72,000	60	15,000	45,000	1911	Hyd.	5,200	45	161	Hor.	Boving	3,700	3,000	.80	6,600	Vickers	3,000	1	△	△		18,000	W.	12,000	60,000	△	△
54	Cie Grenobloise de force et lumiere (*France*)	About 70,000	Direct current	Over 4,000	....	....	Hyd.	1,750	215	300	Hor.	Piccard Pictet & Cie.	...	270	Direct current	3,600	Cie de l'Ind. el. & mec. Geneve	.										
55	Olten-Gosgen Power Plant (*Switzerland*)	70,000	....	....	....	1913	Hyd.	.... ..			....	....	....			...	....	....										

No.	TERMINI	Distance of transmission, miles.		Height, feet.	Span: Normal, feet.	Span: Maximum, feet.	Circuits: Per tower.	Circuits: Total.	Section gauge in circular mils and square inches.	Material.			Arrangement.		Insulators	Manufacturer.		Manufacturer.					
1	Big Creek-[illegible], Cal.	241		About 45-	600	2,000	1	2	605,000 Circ. M 0.475 sq. in. 75,000 Circ. M 0.060 sq. in.	Al		Steel	Hor.		[illegible]	Locke							
2	Au Sable-Battle Creek, Mich.	[illegible]		40-107	500	600	1	1	0 B. & S. 0.083 sq. in.	Cu				208 Slant 111 Vert.	[illegible]	Ohio Brass Co						W G. E.	W G. E.
3	Bishop-San Bernardino, Cal.	[illegible]		70-	600	1,400	2	2	211,100 Circ. M 0.166 sq. in. 34,070 Circ. M 0.027 sq. in.	Al				131 minimum	[illegible]	Locke Ohio Brass Co						G. E.	[illegible]
4	Grace, Idaho-Salt Lake City, Utah	[illegible]		52-	600	2,300	2	2	250,000 Circ. M 0.196 sq. in.	Cu	12			126 minimum	[illegible]	Thomas Ohio Brass Co						G. E.	W Bowie
5	Drum-Cordelia, Cal.	[illegible]		50-52	500	2,350	1 and 2	1	000 B. & S. 0.132 sq. in. 258,000 Circ. M 0.210 sq. in.	Cu Al	10	[illegible]				Ohio Brass Co					Al	G. E.	G. E.
6	Cheat Haven-Butler, Pa.	[illegible]		11-80	528		2	2	0 B. & S. 0.083 sq. in.	Cu			Vert.	60		Penna. [illegible] Co							P. G. & El.
7	Cleveland-Nashville, Tenn.	[illegible]		50-210	600	[illegible]	1 and 2	2	00 B. & S. 0.105 sq. in.	Cu			Hor.			Ohio Brass Co							W
8	Shelburne Falls-Millbury, Mass.	[illegible]		[illegible]	600	1,200	2	2	00 B. & S. 0.105 sq. in.	Cu			Vert.			Locke							
9	Lake Inawashiro-Tokio, Japan.	[illegible]		70-220	550	1,530	2	1	100 Sq. Mm. 0.155 sq. in.	Cu				122 Slant 120 Vert.	[illegible]	Special Thomas							
10	Croton-Grand Rapids and Muskegon, Mich.	[illegible]		53-80	528			2	2 B. & S. 0.052 sq. in.	Cu		Hemp				G. E.							W
11	Niagara Falls-Toronto and St. Thomas, Canada	[illegible]		61.5-170	550	1,100	2	4	0000 B. & S. 0.166 sq. in. 000 B. & S. 0.132 sq. in.	Cu Al		Steel Cu Al	Vert.			Locke Ohio Brass Co Hermsdorf						W G. E.	W G. E.
12	Lauchhammer Mines-Riesa, Germany	[illegible]		60-65	550	900	2	2	42 Sq. Mm 0.066 sq. in.	Cu		Cu			Susp.	Hermsdorf							S.-S.
13	Tallulah Falls, Lindale, Atlanta, Ga., etc.	170		60-105	550	1,200	2	2	0000 B. & S. 0.166 sq. in. 00 B. & S. 0.105 sq. in.	Cu		Cu	Vert.	108	4-Susp 5-Susp	Thomas Ohio Brass Co						G. E.	W. G. E.
14	Coosa River-Birmingham, etc., Ala.	150		65-[illegible]	600-700	900-1,200	2	2	00 B. & S. 0.105 sq. in.	Cu				122 Slant 120 Vert.	6-Susp	Locke Thomas Ohio Brass Co						W	W G. E.
15	Keokuk, Iowa-St. Louis, Mo.	144		70-231	800	3,300	2	2	300,000 Circ. M 0.235 sq. in.	Cu			Vert.	120	[illegible]	Locke Ohio Brass Co		Locke			Al	[illegible]	[illegible]
16	Hauto-Siegfried, Pa.	[illegible]		78.5	600	2,000	2	2	250,000 Circ. M 0.196 sq. in.	Cu		Cu	Vert.	120	6-Susp	Locke		Locke	Steel		Al	W	W
17	Cedar Rapids, Canada-Massena, N. Y.	60	S. T.	70	600		2	2	300,000 Circ. M [illegible] sq. in.	Al		Steel	Vert.	120		Locke		Locke					
18	Boquilla-Parral, Chihuahua, Mexico	[illegible]	S. T.	65-90	[illegible]	1,100	2	2	280,000 Circ. M 0.220 sq. in.	Al	7	Al		122 Slant 120 Vert.	5-Susp 7-Susp	Locke Ohio Brass Co			Steel ½ In			G. E.	[illegible]
19	Segre River-Barcelona, Spain	105		65-	[illegible]	1,500		4	0000 B. & S. 0.166 sq. in.	Cu					Miscellaneous Pin	Several			Steel ½ In		Al	G. E.	[illegible]
20	Tocopilla-Chuquicamata, Chile.	86	S. T.	47	650		1	1	000 B. & S. 0.132 sq. in.	Cu		Cu	Hor.	[illegible]	7-Susp	Locke			Steel ½ In		Horn and [illegible]	S.-S.	[illegible]
21	Mill Creek-Oakland, Cal.								....														
22	Stanislaus-San Francisco, Cal.	158		65-	850	1,600	1 and 2	2	00 B. & S. 0.105 sq. in.	Cu	6	Hemp	Vert.		[illegible]-Pin	Ohio Brass Co Locke		Ohio Brass Co Locke		None	Al	G. E.	G. E.
23	Great Falls-Butte and Anaconda, Mont.	150	S. T.	45-	600	3,034	1	2	0 B. & S. 0.083 sq. in.	Cu	6	Hemp	Hor.	[illegible]	[illegible]	Ohio Brass Co		Ohio Brass Co	[illegible]		Al	G. E.	W G. E.
24	Blewitts Falls-[illegible] and Lumberton, N. C.	96	S. T.	72.6-	650	1,455	2	2	0 B. & S. 0.083 sq. in.	Cu.	6	None	Vert.	108	7-Susp 6-Susp	Thomas		[illegible]		1	Al	G. E.	[illegible]
25	[illegible]-Denver, Colo.	152	S. T.	112-	660	2,900	1	1	0 B. & S. 0.083 sq. in.	Cu	6	Hemp	H[illegible]										
26	Big Bend-Oakland, Cal.	154	S. T.	[illegible] 210	750	2,740	2	2	000 B. & S. 0.132 sq. in.	Cu	7		Vert.	120	[illegible]-Susp	Ohio Brass Co Thomas	Susp	Thomas					
27	Great Falls, S. C.-Durham, N. C.	210	S. T.	[illegible]	600	1,800	1 and 2	2	00 B. & S. 0.105 sq. in.	Cu. Al.	7	Cu Al	Vert.	124	4-Susp. [illegible]-Susp. 1-Susp.	Thomas Ohio Brass Co Locke	5-Susp 8-Susp. 5-Susp	Thomas Ohio Brass Co Locke	Steel ½ In		Al	W	W
28	Shawenegan Fall-Montreal, Canada	81	S. T.	[illegible]	[illegible]	1,400	2	2	250,000 Circ. M 0.196 sq. in.	Al	10	Al	Vert.	96	7-Susp	Ohio Brass Co	8-Susp	Ohio Brass Co	Steel ½ In		Al		
29	San Francisquito-Los Angeles, Cal.	47	S. T.	50-	650	1,750	2	4	250,000 Circ. M 0.196 sq. in. 300,000 Circ. M 0.235 sq. in.	Cu	10	Cu	Vert.	120	7-Susp	Ohio Brass Co	8-Susp	Ohio Brass Co	Steel		Al		W
30	Khopoli-Bombay, India	43	S. T.	66-100	500	1,175	2	2	0.095 sq. in.	Cu				[illegible]	6-Susp	Bullers	7-Susp	Bullers		?	Al		
31	Hamburg-Ludwigshafen, Germany	65	S. P.	67.3	656	740	1	1	50 Sq. Mm 0.078 sq. in.	Cu.	19	Cu		107	7-Susp	Hermsdorf	6-Susp	Hermsdorf		None?	Horn and Res.	S.-S.	S.-S.
32	Pescara River-Naples, Italy	154	S. P.	59.4-65	656	1,174	1	2	66 Sq. Mm 0.102 sq. in.	Cu		Cu		85	1-Pin	Richard Ginori	1-Pin	Richard Ginori		None	Horn and Water Jet	Br Bov	Br Bov
33	New River-Roanoke, Va., Coalwood and Bluefield, W. Va.	75	W. P.	30-	250	1,200	1	1	0 B. & S. 0.083 sq. in.	Al		Al		96	4-Susp	Thomas	5-Susp	Thomas	Steel ½ In		Al	G. E.	G. E.
34	Lages River-Rio Janeiro, Brazil.	51	S. T.	56-71	400 500	1,935	2	4	000 B. & S. 0.132 sq. in.	Cu	6	Hemp		96	Miscellaneous Pin	Thomas	5-Susp	Locke	Steel ½ In	1	Horn and Lig[illegible]	W G. E.	W
35	Sorocaba-Sao Paulo, Brazil.	56	S. T.	65	750	[illegible]	2	4	00 B. & S. 0.105 sq. in.	Cu.		Cu		90	Miscellaneous Pin	Several	5-Susp	Several	Steel ½ In		Al	G. E.	G. E.
36	River Ouse-Hobart, Tasmania	61																			Al	W	W
37	Necaxa-Mexico City, Mexico	160	S. T.	57-	500 750	1,500	2	4	0000 B. & S. 0.166 sq. in.	Cu	6	Hemp		72	3-Pin	Thomas	3-Pin	Thomas	Steel	1	Al	G. E.	G. E.
38	Niagara Falls-Toronto, Canada.	80	S. T.	[illegible]	400 650	800	2	4	190,000 Circ. M 0.149 sq. in.	Cu	7	Cu		72 96	Miscellaneous Pin	Locke Thomas	5-Susp	Locke	Steel ½ In	1	Horn	G. E.	S.-S. G. E.
39	Vereeniging-Johannesburg, South Africa	30	S. T.	[illegible]	500		2	1	60 Sq. Mm. 0.093 sq. in.	Cu.	Yes			110	6-Susp	G. E.	6-Susp	G. E.	Steel [illegible] Mm	1	Horn and Res. Al	A. E. G. G. E.	S.-S. A. E. G. W
40	Hannawa Falls-Potsdam, N. Y.	60	S. T.		550				0 B. & S. 0.083 sq. in.	Al				108	7-Susp	Locke	6-Susp	Locke					
41	Pyrenees Mountains-Barcelona, Spain.	107	S. P.		560		2	2	79 Sq. Mm. 0.122 sq. in.	Cu.				79	Susp	Hermsdorf Rosenthal	Susp	Hermsdorf Rosenthal			Horn and Res.	S. S.	
42	Komahashi-Tokio, Japan	48	S. T.		[illegible]	850	1 and 2	2	18-No. 12 B. W. G. 0.168 sq. in.	Cu	18	Hemp		81	1-Pin	Nippon Tokio K[illegible]			Steel 3 B. & S.	1	Al	G. E.	G. E.
43	Kern River-Los Angeles, Cal.	117	S. T.	[illegible]-110	700	1,500	2	2	0000 B. & S. 0.166 sq. in.	Cu	7	Cu		72	4-Pin and Susp	Ohio Brass Co Thomas Locke	Pin	Ohio Brass Co		None	Multiplex Al	G. E.	G. E.
44	Rogers Dam-Muskegon, Mich.	60	W. P.	[illegible]	[illegible]		1	1	2 B. & S. 0.052 sq. in.	Cu.	No	Cu.		50 Av.	4-Pin	Locke	4-Pin	Locke	Steel No. 10	1	Stat. Ind. and M[illegible]	W	W
45	Grossolo-Milan, Italy	93	S. P. ?	65.6	656	1,066	2	4	80 Sq. Mm 0.124 sq. in.	Cu.	19	Cu		61	Pin	Richard Ginori	Pin	Richard Ginori		None	H and R W. J., Cyl.	Several	Br Bov
46	Cedegolo-Milan, Italy	72	S. P.	60-	607		1	2	79 Sq. Mm 0.122 sq. in.	Cu				[illegible]	4-Pin	Osculati and Carini	4-Pin	Osculati and Carini		None	Horn and Res.	A. E. G.	A. E. G.
47	Canyon Ferry, Hauser Lake-Butte, Mont.	[illegible]	W. P.	10-	110	[illegible]		2	0 B. & S. 0.083 sq. in.	Cu.		Cu		72	1-Pin Glass	Hemingray	Glass	Hemingray		None	Al	W	W
48	Molina-Madrid, Spain	[illegible]	W. P.	40-50	328			2	50 Sq. Mm 0.078 sq. in.	Cu.	1	Cu		71	Pin	Hermsdorf Rosenthal	Pin	Hermsdorf Rosenthal		None	Horn and Res.	S.-S.	S. S.
49	Holtwood, Pa.-Baltimore, Md.	40	S. T.	40-	500	1,750	2	4	300,000 Circ. M 0.235 sq. in.	Al		Al.	Vert.	84	5-Susp 7-Susp.	Ohio Brass Co	6-Susp 8-Susp	Ohio Brass Co	Steel ½ In	1	Al	G. E. W	G. E.
50	Santiago River-Guadalajara, et al., Mexico	[illegible]	S. T.	19	600	1,803	1	1	00 Sq. Mm 0.78 sq. in.	Cu	19	Cu		[illegible]	5-Susp	Hermsdorf	6-Susp	Hermsdorf	Steel ½ In	1	Al Horn and Res.	W S.-S.	S.-S.
51	S. Dalmazzo-Noli, et al., Italy	[illegible]	S. P.	30.1	164	2,300	2	4	75 Sq. Mm 0.121 sq. in.	Cu		Cu.	..	65	Pin	Richard Ginori	Pin	Richard Ginori		None?	Horn W. J., [illegible]	A. E. G. Fribourg	A. E. G. Br Bov
52	Porjus-Kiruna, Sweden.	73.4	S. T.		625	[illegible]	2	2	40 Sq. Mm 0.062 sq. in.	Cu			Hor.	156	6-Susp		6-Susp		Iron [illegible] Sq. Mm	1	Horn and Res.		
53	Point Dubois-Winnipeg, Canada	77	S. T.	42-90	600	939	2	2	278,600 Circ. M 0.219 sq. in.	Al	19	Al		72	4-Pin	Locke	1-Pin	Locke	In exposed place only	1	Al	W	W
54	Pombliere-Lyon, France	111	W. P. S. P.				1	1	64 Sq. Mm 0.099 sq. in.	Cu.				157	3-Pin		3-Pin			None?	Horn and Res.		Cie de l'Ind. el. & mec. Geneve
55	Anwil-Bollmingen, Switzerland	19	S. P.	73	590	..	2	2	60 Sq. Mm. 0.093 sq. in.	Cu.	10	Cu		112 Slant 110 Vert.	4-Susp.	Rosenthal	4-Susp	Rosenthal	Steel 10 Sq. Mm.	1			

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obtainable, at merely the expense of the pumping plant, 170 additional kilowatts for 10 months in the year, amounting to a yearly output of nearly 1,250,000 kilowatt hours. It is sufficiently obvious that this additional supply, as large as that delivered by the central station in many a small eastern city, is a valuable asset. In point of fact, the saving is more than enough to pay for the pumping plant in a single year. It is an extraordinary case of "hoisting yourself by your jack boots," which only electricity could do in this fashion.

Development work done by U. S. Reclamation Service.—It is not perhaps generally recognized that the United States Reclamation Service work has carried with it a great deal of incidental power development. The following is from an article[1] by Mr. C. J. Blanchard, of the Service:

> In the working out of a definite plan for the utilization of our natural resources and particularly the water powers, only one Federal bureau has been actually engaged in the engineering work of developing power. The Reclamation Service, organized in 1902 for the purpose of making habitable large areas of irrigable public lands, has constructed a number of power plants and has launched the Government in the power-producing business in several localities. Originally the idea of power development was solely for the purpose of pumping water to lands above the reach of the gravity canals, but wise management decreed when there was demand for surplus power that all such power which could be economically developed should be provided for in the construction of the plant. In this way the Government has found itself in the field as a maker and seller of electric power. It is a rather advanced step in the governmental activities, but no one has yet seriously questioned its practicability and certainly no one can gainsay its success financially.
>
> The following table shows the present condition as well as the possibilities of power development on the reclamation projects:

PROJECT.	Horse-power devel-oped.	Possible horse-power.
Total	27,670	394,845
Arizona, Salt River	9,030	20,000
Arizona, Yuma		600
California, Orland		(1)
Colorado, Uncompahgre		10,000
Colorado, Grand Valley		2,000
Idaho, Boise	3,000	3,000
Idaho, Minidoka	10,000	30,000
Montana, Huntley	380	380
Montana, Lower Yellowstone		290
Montana, Sun River		(1)
Montana, Flathead		300,000
Nebraska-Wyoming, North Platte		(1)
Nevada, Truckee-Carson	1,660	8,000
New Mexico, Rio Grande		(1)
North Dakota, Williston	3,000	3,000
Oregon, Klamath		(1)
Oregon, Umatilla		75
Utah, Strawberry Valley	1,600	3,500
Washington, Yakima		15,000
Wyoming, Shoshone		(1)

(1) Not determined.

Discussing all these general conditions, and some of the data already presented, it is remarked by a leading expert, Dr. Louis Bell:[2]

> A conspicuous item of the year in hydraulics was the sensational performance of the 6,000-horsepower turbines for the Appalachian Power Co. These wheels under test reached the highest point of full-load efficiency that has yet been recorded, 93.7 per cent, and at moderate loads still showed efficiencies well above those heretofore recorded for wheels under similar conditions. This remarkable performance resulted in an efficiency of 88 per cent from water to busbars, again a record figure well maintained at more moderate loads. The point of the matter seems to be that with wheels working under sufficient head to give a fairly normal design remarkable efficiencies can be obtained provided the output is sufficiently great. Wheels operating under freak conditions of speed or head can not be expected to do so well, yet it is very evident that wheel design on the whole has been so far improved within the past few years as to reduce greatly all the losses save those which must be classified as physically unavoidable. Another plant worthy of special notice on account of the hydraulic situation is that of Hale's Bar, on the Tennessee River. Here the fundamental difficulty is variable head, and in this case the variation between low water and flood is from 40 feet to as low as 19 feet. This very uncomfortable situation was met by placing three turbines on each vertical generator shaft, two of them being used together at times of fairly high head and moderate flow, and the third added only when the head is reduced by flood conditions. This is, of course, an extreme of variable head, but no better solution of the difficulty has been devised than this of multiple wheels. When the head is sufficiently high, placing them separately on the shaft, as at Hale's Bar, is the natural arrangement. The arrangement tried on one of the well-known Swiss plants, a composite runner with three sets of buckets arranged radially to meet the difficulty of extreme low head, has not yet been used in America. Nor has the scheme, tried years ago in one of the plants on the Willamette, of an additional turbine coupled to a separate shaft for low-head work connected to the dynamo shaft by pulleys and a wide belt, been repeated elsewhere.

TRANSMISSION SYSTEMS.

The transmission lines themselves have necessarily been the subject of much consideration in recent years, involving many technical problems, aside from those associated with rights of way, relationship to other electrical circuits of lower voltage, and the crossing of steam railway tracks. Incidentally, details have already been given in the foregoing text as to some of the lines, and a valuable table is herewith presented which affords a survey of the whole situation of the development during the census period 1907–1912 and its results during 1913. Owing to its great range there may be incidental minor errors or omissions, but its broad survey may be taken as comprehensively correct.

Increase in voltage.—The significant fact brought out by this table is the remarkable advance in the voltage or pressure of current on the circuits. A few years ago, pressures of 10,000 or 15,000 volts for transmission were regarded as extreme, but the table assumes that anything below 70,000 volts is now merely for "distribution" and should not be included in "transmission." In line with this is the ruling of the state commission of Virginia, which in dealing with a proposal to carry a 110,000-volt line along a railroad right of way, decided favorably as to its feasibility and safety. It has become altogether a matter of proper construction. The whole tendency has been toward the placing of these high-voltage circuits on steel towers, but a great many lines in the pressures below 70,000 volts are carried on wooden poles.

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[1] Scientific American, Apr. 5, 1913.

[2] Electrical World, Jan. 3, 1914.

Tower and line construction and installation.—A typical steel-tower installation at high voltage was that put in operation in 1911 for 135,000-volt transmission from Au Sable to Flint, Mich., 125 miles away, and also to Battle Creek, 65 miles farther, tying in at various other points to the 44,000-volt network spread out over southern and central Michigan. The transmission line comprises a single 3-phase circuit of three No. 9 copper wires carried on suspension-type insulators hung from the cross arms of 55-foot steel towers. Two braced bracket arms extend from one side and one arm from the other, carrying the wires at the apices of a tipped isosceles triangle with a 12-foot base and 17-foot sides. The lowest wire is 40 feet above the ground. The suspension insulators to be used have eight disks linked in series, each disk having been tested to withstand 75,000 volts continuously, and 100,000 volts for a brief period. Each complete eight-disk porcelain insulator measures 52 inches from the tower hook to the line conductor.

A clear right of way into each substation was purchased for the 135,000-volt lines. At the substation the end wall of the building is apparently cut away, leaving only a hanging pediment which serves as a rain shield to protect the vertically downward entries of the wires through bushings in a horizontal shell carried by a second wall several feet inside the building line. The high-tension lines are delta connected to the transformers, subjecting the insulation to the entire 135,000-volt stress. It appears that a line of such high insulation is little injured by lightning strokes. In fact, the 110,000-volt Grand Rapids line has given less trouble than many others of much lower potential in the system, and although afforded no lightning protection, has operated through the most severe storms without interruption.

During 1912 the Central Colorado Power Co. adopted a wooden transmission-tower construction for a new 70-mile line at 100,000 volts. Each tower comprises one 45-foot and one 40-foot pole, which are set into the ground to a depth of 5 feet 6 inches. At the ground the poles are separated by a distance of 17 feet 6 inches, and converge to a distance of 11 feet at a level 35 feet above the ground. The cross arm is formed of a pair of 4-inch, $5\frac{1}{4}$-pound steel channels bolted together at their ends and inclosing the poles as a bow spring. Although pinned to the poles by through bolts, the spring pressure of these deflected channels is sufficient to hold them securely in position. A 10-inch spacing block is inserted at the mid-point of the bow, and the channels are braced to the poles with 4-foot knee pieces. These towers are spaced at 500-foot intervals throughout the 70-mile line. The arrangement of the suspension insulators places all 3-phase wires in the same plane. The ground wire is carried at a distance of nearly 8 feet from the nearest conductor. At each pole a ground tap is run down under staples and wrapped in a spiral about the pole butt to provide a permanent earth connection. The Central Colorado Co. has used a construction similar to this in some of its 13,000-volt lines, where the bow-spring cross arms are formed of two 6-inch by 6-inch hardwood members. With this construction, spans as long as 1,100 feet have been used.

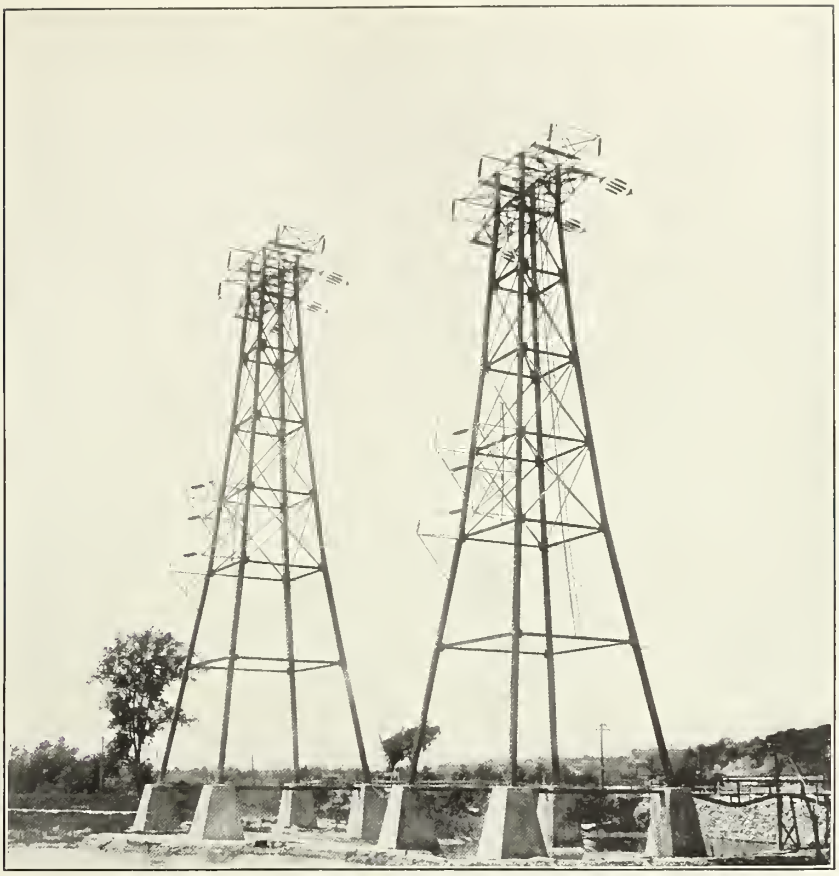
Another special modification used on these 13,000-volt lines, where it is desirable to avoid guying against the fierce winds that prevail in the region, has been an A-frame arrangement. Two 30-foot poles are erected 30 feet apart, at an angle of 30 degrees with the perpendicular, forming an equilateral triangle. The frame is linked and braced by $\frac{5}{8}$-inch bolts extending through plate crosspieces. At distances 6 feet down each pole, measured from the apex of the frame, provision is made for attaching strain insulators, the jumpers between spans passing around the poles. The top wire is then attached to the frame crosspiece, while the lower conductors clear the ground by 20 feet. This construction has been used in a mountainous country for a distance of nearly 3 miles, the maximum of the 47 spans being 1,100 feet.

Some idea of the general conditions prevailing in high-voltage "distribution," as distinguished from "transmission," may be formed from the 1912 report of the committee on electrical transmission of the Ohio Electric Light Association, comprising information as to a number of lines operating at from 6,600 to 33,000 volts in Ohio, Indiana, and Kentucky. The committee reported that the practical working radius of 2,300-volt transmission was very limited, being about 1 mile for 25 cycles and 3,700 feet for 60 cycles, when the wire is loaded to its carrying capacity and the pressure drop is 10 per cent. The transmission-line design centered on the operating voltage. A good rule was 1,000 volts per mile of line. For example, a 6-mile line would require 6,000 volts. The usual spacings were summarized as follows:

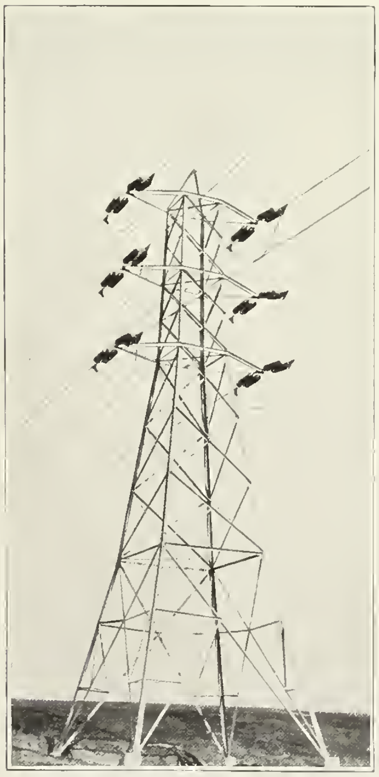
VOLTS.	Minimum spacing, inches.	Maximum spacing, inches.
6,600	12	48
13,200	18	36
22,000	30	36
33,000	36	72

The greater the number of provisions against lightning, the better the possibility of uninterrupted service. The aluminum-cell arrester had proved very efficient. It not only afforded a path to ground for lightning but aided in removing all internal line disturbances. However, this arrester had the disadvantage of the necessity for charging it each day, thus making its efficacy dependent on the operator. The multi-gap arrester

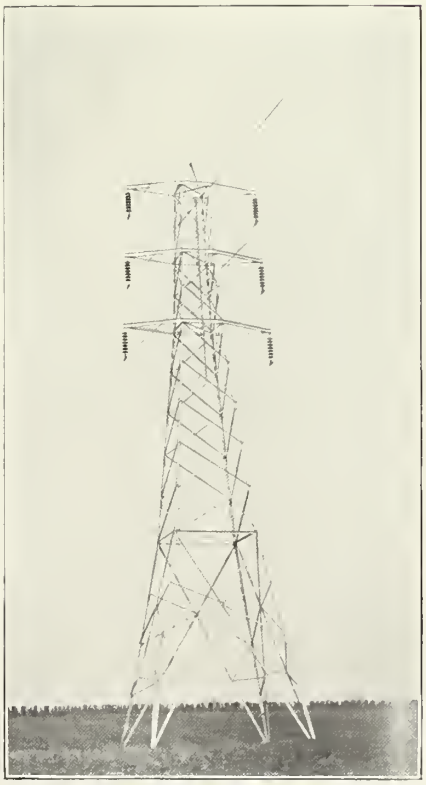
ST. LOUIS TRANSMISSION, MISSISSIPPI RIVER POWER CO.



1. 135-FOOT RIVER-CROSSING TOWERS.



2. DEAD END TOWERS.



3. STANDARD TOWERS.

(Face p. 134.)

also relieved surges and was found very effective up to 13,200 volts. Ground wire was placed at the top of the line structure so that it had a shade angle of 45 degrees to the outside conductors. It might be a ⅜-inch stranded galvanized plow steel or bimetallic wire. The ideal construction comprised ground wires at the highest points of the poles and aluminum-cell arresters at both ends of the line and in the center.

Transmission work in recent years has seen the introduction of a great deal of aluminum for the circuits, its use being naturally controlled more or less by the ruling price for copper. In some instances the newer metal is associated with steel as a core, the same practice being followed also with copper. In the Big Creek-Los Angeles transmission, 241 miles of double circuit, the use of very large steel-core aluminum conductors is to be noted. Following the usual practice of the day, the area of the steel in these cables is approximately one-seventh that of the aluminum, there being seven steel wires around which are stranded 54 aluminum wires, giving the cable a diameter of 950 millimeters. The critical current pressure with this conductor on a 17-foot spacing would be 210,000 volts, so that there is an ample margin against the dangerous formation of "corona" at the normal voltage of the transmission at 150,000; while with copper the spacing between the circuits would be 30 feet to secure the same factor of safety. The Pacific Gas & Electric Co. in California, in carrying out extensions during 1912–13, has made frequent use of aluminum, one of the most important instances being its Drum-Cordelia line. Copper has been used for the conductors on the sea coast and in regions where sleet and snow are most encountered, but elsewhere the line is built of 19-strand aluminum, No. 5 B. & S. gauge. The standard transmission-tower spacing is 800 feet on the level, with which there is no unusual sag with aluminum if freedom from sleet is enjoyed.

Suspension insulators have virtually abolished pin insulators for high-voltage transmission lines, and they are now used exclusively, the practical limit of the pin insulator being about 60,000 volts. The suspension type came into use in 1905 and marks a radical change in methods of operation. In the pin-insulator line, the conductor is held rigidly at every insulator, so that the lateral and longitudinal movement of the conductor is resisted at every point of support, with results that may be seen of all men after a severe snowstorm or a deposition of sleet. Time and again the telegraphic and telephonic systems of the country over large areas have been paralyzed and prostrated by the snapping of the wires or the breakage of the cross arms and poles. Suspension insulators are, however, except at dead-end connections, free to move in all directions, but what is thus gained in flexibility and safety has to be compensated for in large clearance spaces. The displacement of the wires in high winds is dangerous mechanically and electrically, so that longer cross arms are needed, and the height and cost of towers are increased.

Outdoor substations.—The development of outdoor substations has been one of the marked features of the period, associated with long-distance transmission work. The problem of furnishing electricity to isolated communities and consumers has received much attention and is now generally recognized as a serious and important undertaking. There never has been any question as to the desirablity of giving service to outlying territories, providing the investment and maintenance charges were such that a fair return could be expected. Prior to the building of transmission networks and high-tension distribution feeders radiating from central points to small communities, the cost of lines to reach the small consumer, combined with the high cost per kilowatt of switching and protective equipment, practically closed a field now open to development. The situation, therefore, is improved, as the consolidation and unification of central-station systems have resulted in a large mileage of transmission lines passing through the districts ready and waiting for electrical service. The problem has resolved itself into the building of lines from a large-capacity centralized plant to definite points where loads of suitable characteristics to justify the expense can be secured. From these high-tension feeders, branches extend along the way, to farms, mills, stone quarries, grain elevators, irrigation projects, railways, pumping installations, dairy farms, canning factories, brick or tile plants, excavating shovels, etc.

The small generating station supplying a town or village is necessarily at a distinct disadvantage in the generation and distribution of electricity as compared with the larger stations, as the economy is low. This condition is due to the small quantity of power generated, the poor load factor, and the fact that the size of the enterprise does not justify the employment of high-class engineers or operators. The small generating station is therefore being quite generally superseded by a substation, supplied from a high-tension transmission line serving a number of communities. With one or more small towns as a nucleus, the transmission line is built—the first step toward supplying an entire district or even a county from a centralized plant. The supply of power along the main transmission lines has thus become a comparatively simple matter, aided largely by the outdoor substation, reducing the investment required and therewith the cost of the current furnished.

In this class of work the wooden-pole outdoor substation is extensively used. The steel-tower equipment has, however, many advantages and its use is steadily increasing. This is especially true since manufacturers have designed stations with proper equipment for quickly, easily, and cheaply handling heavy transformers. The development of switch gear which will not freeze has also had an important bearing on substation equipment. Improvements in high-tension chemical fuses have been pushed, and the general tendency in all the outdoor equipment has been toward simplicity and cheapness. The operation of outdoor transformers is held to be no longer experimental. In general the type is similar to that for indoor use, except that the cover and the leads are designed to shed moisture and furnish higher factors of safety by superior insulation.

It was to take care of small isolated loads that the development of the outdoor substation began, and these have afforded its greatest field to date. Complete outdoor installations up to several hundred kilovolt-amperes have enabled service to be given to isolated customers and small communities which otherwise could not be profitably served directly from the main transmission lines. It is possible to locate such substations almost anywhere, the structural and foundation requirements varying with conditions. The high-tension switching is usually limited to air-break types, instead of the costly oil switches, while lightning protection is afforded by either the electrolytic lightning arrester or the simpler horn type. Most of these installations have been free from elaborate secondary control, that provided, if any, being of the simplest type and established in weatherproof housings.

The application of the outdoor substation has been carried to large-capacity installations. The substation thus combines not only the functions of a switching station, but that of supplying a large load to a community. With substations of this character, involving attendance, it is necessary to provide a suitable building designed for at least part of the installation. What part of the high-tension apparatus may properly be installed out of doors depends largely on the saving thereby effected. The actual outdoor apparatus must be provided for separately, and a combination of the indoor and outdoor substation will in many cases prove most advantageous. In some cases it is feasible to place the whole outfit out of doors, including the low-tension control equipment, provided the latter is not extensive, but in most cases it is questionable whether the operating conditions permit this extreme. In cases where attendance is required it is believed advisable to install the secondary equipment outdoors. The manner of installing the outdoor equipment depends, of course, upon the size and importance of the layout. In general, the incoming and outgoing lines must have proper terminal structures for connection and distribution to the banks of transformers. The transformers themselves are provided with solid foundations, preferably of concrete, so designed that they may be removed on rails, and provision should be made for heating the cases if climatic conditions require it, while the piping for oil or water must be carefully considered.

A most important detail of the outdoor installation is that of providing proper facilities for repairing damaged apparatus, and large substations provide some shelter where such repairs can properly be made.

The space occupied by the outdoor installation is, of course, large, and adequate provision must be made for preventing anyone from coming in contact with the equipment. The element of safety to employees and the public can not be neglected, especially in view of the fact that the equipment of outdoor installations represented at the end of 1913 no less than 300,000 kilovolt-amperes in high-tension outdoor transformers.[1]

Many illustrations of this class of work might be cited. Among the most recent were two substations installed in 1912–13 by the Amherst (Mass.) Power Co.[2] Of these, one is located at Chicopee and the other at Agawam, Mass., both being supplied from the company's double-circuit, 60-cycle, 3-phase, 66,000-volt transmission line extending from Turners Falls to Springfield, Mass. Each station is of an ultimate 10,000-kilovolt-ampere capacity. In these plants all the high-tension switching apparatus for 66,000 volts and the transformers are out of doors. The low-tension apparatus at 13,200 volts is indoors, as well as apparatus at Agawam distributing at 2,300 volts. The control switchboards and instruments, motor-generator sets, etc., are not developed to the point where it is practical to operate them outside, but it is remarkable that in the exacting climate of New England such a general plan as this can be carried out with a considerable saving in first cost of the substation and no increase in operating expense. The note may be made that oil transformers of the radiator type are used. In outdoor transformers the oil freezes at −15 degrees Centigrade. Steps are taken to keep the temperature of the oil above that point by connecting the apparatus that may be standing idle to the busbar on the low-tension side from about January 1 to March 10 each year, thus securing artificial heat. The transformers and oil switches are connected by a complete piping system to a two-compartment oil tank buried in the ground, so that oil can be drained from any transformer or oil switch into its respective compartment of the oil tank and thence can be pumped through a portable oil-filter press back into the transformers or switches. Alarm thermometers on the transformers are connected to bells in the station. There is installed in the cover of each transformer a small heating unit taking 200 watts at 110 volts. The object of this unit is to keep the air in the top of the transformer, and especially the spare transformer when not excited, a little above the temperature of the air outside, so that in the process of "breathing," which is sure to be present to some extent in any large transformer subjected to varying temperatures, the air taken in, even though heavily laden with moisture, will have that moisture vaporized by coming in contact with the warmer air inside, rather than further condensed by coming in contact with cooler air inside, which would occur if there were no artificial heat inside the cover of the transformer.

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[1] Proceedings, American Institute of Electrical Engineers, February, 1914. Macomber.

[2] Proceedings, American Institute of Electrical Engineers, February, 1914. F. L. Hunt.

When it becomes necessary to disassemble a transformer it is rolled on to a transfer truck upon which it is run into a compartment at one end of the substation where a hoist is available of sufficient capacity to lift and remove the core. Switch hooks, used for operating the disconnecting switches outdoors, are fitted with a copper cone at about the middle of the handle, the cone being grounded when the hook is to be used. All the outdoor aluminum lightning-arrester cans are painted white to overcome a difficulty experienced in climates where the absorption of the sun's heat by dark-colored cans has raised the temperature of the electrolyte of the arrester to a point where it was damaged. Two coats of white paint on these cans have been sufficient to keep the temperature of the arresters below the danger point in these installations, up to the present time. The same treatment may be applied with similar results to the transformers where excessive temperatures are reached on account of the sun's direct rays. The winter-weather test of these substations has been satisfactory in frost, sleet, and snow.

Each outdoor station is surrounded by an iron picket fence and all the equipment is set on concrete foundations extending below frost line and about 15 inches (38.1 centimeters) above the final level of the ground. Thus far in the operation of these stations nothing has occurred which indicates any important point of disadvantage in the outdoor arrangement, except that some difficulty was at first experienced in keeping the joints of the cooling radiators on the transformers oil-tight, due to the wide range in temperature to which they were subjected every 24 hours. The design of these radiators was changed, and the new radiators have thus far stood the test of wide temperature changes without developing leaks.

Outdoor apparatus is also used on this system at several of the local consumers' substations, where energy is delivered to factories, mills, etc., at 13,000 volts and stepped down to 2,300, 550, 440, or other voltages. The transformers are connected to the 13,200-volt circuit through combination horn-gap arresters and choke coils, and horn-gap disconnecting switches, and the power is metered at 13,200 volts by the use of outdoor potential transformers, indoor current transformers under shelter, and a meter in a box with glass cover. The tower stands approximately 20 feet high, the bottom of the transformers being about 10 feet from the ground.

STORAGE BATTERIES.

The use of storage batteries by central stations has continued to extend, and some of these equipments are of extraordinary size. The Consolidated Gas Electric Light & Power Co., of Baltimore, Md., possesses what is held to be the largest single storage-battery installation in the world, the next largest being owned by the New York Edison Co. The Baltimore company has a large steam station at Westport, just on the outskirts of Baltimore. It is also the largest user of the transmitted energy generated by the Pennsylvania Water & Power Co., at Holtwood, Pa., on the Susquehanna River, reference to which has already been made. Ordinarily the greater part of the load in Baltimore is carried by the hydroelectric station at Holtwood, a 40-mile transmission line connecting the terminal receiving station at Highlandtown, Md., with the generating station. In order to safeguard its customers against interrupted supply in case of mishap to the hydroelectric station at Holtwood, to the transmission line, or to the steam station at Westport, it was decided to install the battery. The battery house adjoins the substation of the company on McClellan Street, Baltimore, and was especially designed and constructed for the battery and its equipment. Provision has been made for an additional story to accommodate another battery of similar size, if necessary. The battery comprises 152 cells, each of which contains 133 lead plates. The cells are arranged in four rows and are covered with heavy glass plates. The total weight of the equipment is 616.5 tons. The battery is kept connected to the busbars supplying the direct-current service, and in the event of any interruption can immediately assume the load so as to carry it without interruption to the service. It will deliver 44,000 amperes at 250 volts for six minutes, or 11,000 amperes for one hour. The capacity at the six-minute rate is 11,000 kilowatts. The battery is thus able to carry the entire direct-current load on the system for a period varying from 10 minutes to several hours, depending on the magnitude of the load at the time of discharge.

ARC LAMPS.

It will have been noted that in the statistics for the estimated number of lamps wired for service the total of arc lamps in 1912 was only 505,395, as compared with 555,713 in 1907, thus indicating a 9.1 per cent falling off in that short period, although the whole 10 years showed an increase of 31 per cent. These figures of decline embrace a most interesting chapter in electrical history, and are eloquent as to the rapid changes now going on in the central station art. It is true that in the 10 years the number of arcs operated from municipal plants increased 80.8 per cent, and that from 1907 to 1912 they increased from 82,940 to 91,851, but this is simply a proof that the municipal plants for well-known inherent reasons do not respond so quickly in any of their enterprises as does private capital to advances in invention and industrial art, but follow the more conservative method of adding to an old plant rather than adopting the policy of scrapping it because the apparatus has become obsolete. Usually bonds have been issued for the installation, and the natural tendency is to keep as much of the plant going as possible until full amortization has occurred. In an industry like the central station, where one invention or improvement succeeds another in swift and even startling succession, it becomes imperative to make these advances in order to give the public better and cheaper service with the latest appliances even if relatively new machinery has to be scrapped and new capital risked. Obsolescence plays a large part in the field of electric light and power. It is not to be understood, however, that the municipal lighting systems have fallen behind quite as these figures would indicate, for many of the lamps enumerated are of the later modern types evolved during the period.

The development of the arc lamp as a street illuminant has been treated in earlier central station reports, and an account of the later arcs will be found in the census report on manufactures—Electrical machinery, apparatus, and supplies—for the Thirteenth Census. It may be remembered that single and double carbon, direct-current, open-arc lamps run in series from a constant-current arc generator were at first the base of the whole lighting industry, and they are still in use in some places. Series arcs run from alternating-current machines were little patronized on account of their lower efficiency. Constant-potential direct-current and alternating-current open arcs were in extensive use for a time, not as a part of civic lighting but for auxiliary illumination. About the close of the last century most of the plain open arcs were replaced by inclosed-arc lamps, having an inner globe chamber around the carbons, and were favored on account of their longer carbon life, steadier light, and lower cost and time for trimming, these qualities offsetting a lower efficiency. The direct-current series inclosed arcs were operated from arc dynamos of the old type at higher wattage and the alternating-current lamps were run from constant-current transformers. This latter transformer system has had a very wide use, but has lately been superseded in a large degree by "luminous-arc" lamps on series circuits supplied by mercury rectifiers and constant-current transformers. The use of constant-potential flaming arcs is also increasing. The alternating-current series inclosed-carbon arc lamp of 6.6 amperes has done the bulk of American street lighting for many years in the recent past, while more lately the 4-ampere, 300-watt magnetite or luminous arc has been successful in replacing the carbon arc, giving an available 300 candlepower; the titanium arc of 400 candlepower and 200 watts also making a place for itself. It is here that the issue for supremacy has been joined with the novel large gas-filled mazda or tungsten incandescent street lamps giving 400 candlepower at 300 watts, as compared with the former reigning favorites, especially the old inclosed arc with about 175 mean spherical candlepower. In discussing these changes, the well-known authority, Dr. C. P. Steinmetz, in a recent article,[1] gives a table of relative efficiencies of the various candlepower of illuminants:

RELATIVE EFFICIENCY OF VARIOUS CANDLEPOWER OF ILLUMINANTS.

200 MEAN SPH. C-P.		300 MEAN SPH. C-P.		400 MEAN SPH. C-P.		500 MEAN SPH. C-P.		1,000 MEAN SPH. C-P.	
Type.	Watt.	Type.	Watt.	Type.	Watt.	Type.	Watt.	Type.	Watt.
A-c. carbon	490	A-c. carbon	620	Mazda	620	Standard magnetite	400	Gas-filled mazda	780
D-c. carbon	380	D-c. carbon	480	Standard magnetite	350	Gas-filled mazda	390	Standard magnetite	700
Mazda	310	Mazda	470	Gas-filled mazda	310	Special magnetite	350	Special magnetite	550
		Standard magnetite	300	Special magnetite	290	White flame	350	White flame	520
		Special magnetite	250	Titanium	210	Yellow flame	280	Yellow flame	400
						Titanium	250	Titanium	360

Dr. Steinmetz also says:

> There is a general desire for more light, but more still is the desire for cheaper lighting, and there is a much greater appreciation of getting a reasonable increase of illumination—50 to 100 per cent—at a reduced cost to the city, than there is of getting much more light at the same price; while even a very great increase of light, if accompanied by an increased cost, is rarely acceptable in street lighting, except in special cases of decorative lighting, of white way lighting, etc.; and such special application naturally represents only a small part of the country's lighting. This is well illustrated by the experience of the arc-lighting industry. When the arc-lighting engineers became so interested in "large units" as to lose some interest in the low-power high-efficiency arcs and began to push the big luminous or flame arcs, the replacement of the 175-candlepower inclosed-carbon arc by low-power luminous arcs, which had been going on rapidly before, practically stopped, and the country turned to the mazda incandescent lamp, which offered lower power and therefore cheaper units.

It will certainly be very interesting, therefore, to see where the arc lamp is placed relatively at the close of the period 1912–1917, but obviously meantime there is being a great deal of work done with over half a million of these large units in service. Much of this work with the flaming arc is for commercial purposes, but there are many excellent street-lighting systems with the other modern arcs, one of the best being notably that with the 6.6-ampere luminous arc in the central section of the city of Washington along Pennsylvania Avenue, the same city having also a system of incandescent street lighting. Figures of interest are given by Mr. Walter C. Allen, the electrical engineer of the District of Columbia, for the main avenue, as follows, as to lighting with the luminous arcs:

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[1] General Electric Review, Vol. XVII, No. 3, March, 1914.

Length of roadway on center line, 6,356 feet.
Width of roadway, 109 feet.
Square feet of roadway, 692,804 feet.
Number of lamps, 123.
Total watts at 520 each, 63,960.
Annual maintenance cost ($97.50 each), $11,992.50.
Watts per linear foot, 10.06.
Watts per square foot, 0.0923.
Cost to maintain per linear foot, $1.886.
Cost to maintain per square foot, $0.0173.

The cost of installation is estimated to be $170 per unit, exclusive of the posts, ribbed frames, glass, and special parts, which are furnished by the District and cost as follows:

	Cost.
Cast-iron post	$26.90
Cast aluminum ribbed spherical frame	37.50
Special parts	3.00
Total	67.40

The work of installing the cables, erecting the posts, etc., was done by the Potomac Electric Power Co. at its own expense. The company also maintains the lamps at the rate of $97.50 each per annum, less $4.40 deducted as interest and depreciation on the municipally owned posts, in accordance with the acts of Congress establishing rates for street lighting in the District of Columbia.

Another recent installation of similar character was that made by the Lynn (Mass.) Gas & Electric Co. for the Massachusetts Metropolitan Park Commission along two miles of the North Shore Boulevard, with 40 luminous arcs, operating on a 4-ampere rectifier circuit and consuming about 300 watts each. The lamps are carried on slender iron posts 18 feet high, spaced from 200 to 300 feet apart. They give, at a less cost, some twelve times the illumination of the gasoline lamps previously used.

This resort to low posts for the modern arcs is becoming quite general, having been inaugurated in 1912 at New Haven, Conn., when a "White Way," comprising two of the principal business streets, was dedicated with most impressive ceremonies, and a slogan sign, "Old Elms but New Ideas," was flashed upon the gaze of over 100,000 enthusiastic celebrants. The "boulevard" luminous arc was then put in service for the first time, with 78 "inverted" 6.6-ampere lamps, on 11.5-foot posts, spaced at intervals averaging 87 feet, and staggered on opposite sides of the two streets. By "inverted" is meant that the globe of the lamp is placed above the mechanism instead of below it, as usual. The effect of the illumination is most pleasing and satisfactory, and the installation has marked the point of a new departure in an effective response of the modern arc on low posts to the ornamental street lighting with tungstens that has threatened the old supremacy of the arc outdoors. The minimum illumination is estimated at about 2 foot-candles, which is quite high by street-lighting standards.

In other parts of the country the progress of the luminous and other arcs for street lighting is quite noticeable. The city of Baltimore now has 365 or more luminous arcs on ornamental posts distributed over 2½ miles of business streets, in an area comprising nearly 50 blocks, the lamps being of the inverted type rated at 6.6 amperes. The posts are 14.5 feet high. The merchants paid the initial cost of the lamps, the Consolidated Gas Electric Light & Power Co. obtaining this money from the city and the latter collecting from the merchants. The lamps and posts erected represent an investment of approximately $105 each, and are spaced from 50 feet up, according to the amount of money collected, which ranged from approximately $2 a front foot to $1.20 a front foot.

The city of Rochester, N. Y., may be mentioned as one which had 86 of the same type of 6.6-ampere magnetite arcs installed during 1912 in East Avenue, one of the finest residential streets, running from the center of the town to the city line, the lamps being placed 200 feet feet apart and staggered. The cost was borne partly by local assessment on the abutting property, and the rest came out of the general lighting fund.

Omaha, Nebr., has completed the installation of 140 10-ampere flaming-arc lamps, placed four to the 350-foot block on downtown thoroughfares. In each block the lamps, two on a side, are so staggered as to bring one unit to every 90 feet of street length. They are hung from ornamental gooseneck arms 20 feet above the street surface. In each block it was found possible to use one of the two former lampposts in its existing position, moving the other to a new location to conform to the installation of the two new posts per block. The Omaha Electric Light & Power Co. installed the entire system, including conduit, cable, posts, labor, and repaving, for $15,000. This, of course, was exclusive of the lamps themselves, which cost $32 each. The Omaha company is under contract to do the city lighting for $75 to $85 per lamp year, but as the city receives a rebate in the form of a lighting assessment of 3 per cent of the company's gross income, besides a 3 per cent occupation tax payable into the general fund, the net cost per lamp year is but $68 to $70. The system is to be extended to outlying districts.

The adoption of a new lighting system for Federal Street, Pittsburgh, Pa., was brought about by the influence of the local North Side Board of Trade. The grade of Federal Street had been raised considerably in order to place it above the flood level. With the street in a much better condition than previously, it was decided to complete the improvements with an efficient lighting system. After an investigation of the subject, a long-burning flaming-arc lamp was adopted. This was the lamp used to illuminate the hall at Baltimore where the latest Democratic national convention was held nominating President Wilson. There are installed 90 lamps in all, each with the commercial rating of 3,000 candlepower. The street is 48 feet wide and the lamps are placed 60 feet apart. They are hung on ornamental poles of colonial pattern, 25 feet high, with ornamental goosenecks.

The lighting of the luminous-arc lamp standards in Utica, N. Y., in 1912 was made the basis of a public celebration. The installation, which is fed from the circuits of the Utica Gas & Electric Co., consists of 66 inverted-type luminous-arc lamps rated at 6.6 amperes and installed on cast-iron posts spaced 85 feet apart along both sides of Genesee Street, from Bragg Square to the first block above the city hall, a distance of about one-half mile. The lamps were installed at the expense of the merchants and business men along this section of the street, and their maintenance after January 1, 1913, falls to the city under the regular contract for street lighting.

Houston, Tex., and Missoula, Mont., may be cited as examples of places where the new magnetite lighting has been coupled with the use of the trolley poles. In the summer of 1912 the Houston (Tex.) Lighting & Power Co. completed the installation of 80 handsome iron poles carrying 4-ampere magnetite arc lamps which furnished illumination for the business district of the city. These poles are of an attractive design, originated locally and built to conform in base pattern with the new trolley poles in the business streets, in some cases combination poles being used for both railway and lighting purposes. The standard arc-lamp poles are, respectively, 6 inches, 5 inches, and 4 inches in diameter, tapering in three sections. The combination trolley and arc-lamp poles are 8 inches, 7 inches, and 6 inches in section and weigh 800 pounds each. Three-inch pipe forms the gooseneck, the lamp itself being suspended with the arc 19 feet above the roadway. There are four lamps to each 330-foot block in the downtown section, the posts being staggered so that each corner is lighted by two lamps, while the greatest mid-block distance between lamps is about 110 feet. Lead-covered, paper-insulated No. 6 single conductor cable is used to convey the current to the lamps. The lamps are trimmed with the aid of a ladder wagon. Alba globes are used to diffuse the direct rays of the 4-ampere magnetite arcs, but these have been replaced in some cases with clear glass to increase the light from the lamps. At Missoula the 100-foot-wide main street, Higgins Avenue, is lighted for a distance of nearly one mile by 6.6-ampere magnetite arcs of the inverted type carried on trolley-pole brackets at 100-foot intervals, the lamps being held up by 24-inch straight bracket arms 18 feet from the street surface. The erection of the system was facilitated, it is said, by the Montana state law which provides for the creation of special lighting-improvement districts. The law specifies that "the portion of the entire cost of erecting and maintaining posts and of the annual maintenance of lamps therein in such district, not less than one-fourth nor more than three-fourths, as shall be determined by the city council, shall be borne by property embraced within said district abutting upon some portion of the street or avenue within such district to be lighted." To create such an improvement district requires the consent of 51 per cent of the abutting property holders, in addition to an ordinance passed by the local city government. The Missoula Light & Water Co., however, went even further in its initiative, offering to assume the entire expense of installation on the assurance of a three-year contract for the lighting. The proposition was accepted without opposition, and the introduction of the system has already led to a strong demand throughout the city for better street lighting everywhere. That is really what all our cities need, for the standard of street illumination is still at a low point.

Other instances of the new street lighting could be mentioned here, the installations in some cases having been made in record time, but those just given must suffice. It may be noted that in Chicago, outside of street lighting, the South Side Park Commission is using 280 flaming arcs of 7.5 amperes to replace the former inclosed carbon arc lamps at important boulevard and drive intersections, adding to the safety of travel on foot or by vehicle and saving the turf from invasion. Until a short time ago the streets of Chicago were very badly lighted by the municipal plant with lamps of an old type poorly installed, but recent changes are putting that city in the front rank of progress as to arc lighting, a transition having been made to flaming arcs, of which two or three types are used. Several thousand have been installed, and a total of not less than 62,000 is proposed. This is a notable advance. In the residence section these arcs are installed, one at every street intersection and alley, and under no circumstances more than 350 feet apart. These are hung 22 to 23 feet from the sidewalk. In the business section two lamps are placed at every street intersection, and one at each alley intersection, and never more than 250 feet apart. The lamps in this section are 25 feet above the sidewalk. The lamp is carried on a 30-inch bracket, with automatic series cut-outs, and is lowered for trimming, the lowering gear being entirely concealed.

Very many attempts have been made to light large outdoor spaces by means of plain carbon-fed arc lamps, but the newer attempts are based upon the use of flaming arcs with the modern impregnated carbon. The effect is different in the extreme, and, according to all reports, much more successful. Two of the examples are furnished by Chicago. In July, 1910, a military tournament was given at night in an arena 400 by 600 feet, surrounded by tiers of seats about 100 feet deep, making a total of about 11 acres. The seats accommodated 40,000 people. This vast open space was illuminated by eighty 550-watt flaming arcs, hung 50 feet between centers, in 10 spans of 8 each. They were suspended by drop wires at a uniform height of 35 feet above the arena from 600-foot twin spans of steel messenger wire passing over 50-foot poles set back of the seats and guyed from the tops of 40-foot poles, which in turn were anchored. The lamps were fed with 60-cycle current, two in series across each side of a 110–220-volt 3-wire circuit supplied from a temporary transformer installation. In the arena nearly 3,000 soldiers took part in all kinds of drills and evolutions twice daily, and every one, including the soldiers, seemed very well pleased with the quality and intensity of the evening illumination. An average intensity of about 1 foot-candle was obtained, the lights being concentrated above the arena. Readings at the center of the field gave an average of 1.35 foot-candle illumination. The energy consumption was about 0.18 watt per square foot. The work was done by the local Commonwealth Edison Co.

Although opal globes were used in this experiment, some inconvenience from glare was experienced, and another effect, even on a clear night after rain, was that of a luminous mist over the arena, due to the dust. Both conditions seemed susceptible of improvement. Another attempt along different lines was made at Chicago in August of 1910 at the new American League Baseball Park, where the low score of 3 to 0 for the game showed how effective the illumination was. The park contains about 8 acres and seats about 32,000 persons, with the usual spaces allotted to the stands and the "diamond." The total installation consisted of 20 powerful flaming arcs with 1¼-inch carbons taking about 100 amperes each. Ten of the lamps were placed on 80-foot towers or on the grandstand roof, and the other 10 were placed around the park about 7 feet above the ground and were used only when the game was played. Of the high lamps two were placed on a 30-foot tower over the right pavilion flanking the grandstand, and two similarly over the left pavilion. The preponderance of light was on the first-base side, where most of the plays are made. This scenic lighting was supplemented by service lighting to the extent of 150 tungsten lamps of 100 watts placed in passageways and exits. The total load was about 250 kilowatts.

It should be added that high poles or standards for arc lamps are still in vogue, and they are of increasing beauty, serving as ornaments to the street instead of as disfigurements, as was so often the case in earlier years. Many separate arc pole lines have been abolished by the joint use of trolley poles.

INCANDESCENT LAMPS.

Street lighting.—Street lighting by incandescent lamps is so intimately connected with arc street lighting and has developed so enormously of recent years in competition with the older method that it is fitting to discuss it here, taking up later the incandescent lamp itself. There is nothing new about street lighting by incandescent lamps. It goes back to an early stage of the art. But the differences in practice have been radical. The primitive illumination of this type was attempted with small units, single carbon-filament lamps carried on brackets. Much of this lighting still prevails, although marked improvement has been seen in the adoption of metallic-filament single lamps placed on low posts or standards of wood, metal, or concrete; and the streets of numerous rural or suburban communities are lighted in this manner. The great change has come about chiefly through the adoption of group or clustered lamps on low standards; and now the introduction of the much larger tungsten units, ranging up as high as from 300 to 5,000 candle-power, has injected new elements for consideration into the vexing problem of what is really best to-day for street illumination. These larger, high-power incandescent units are, however, mounted on tall poles in the same manner as the familiar large arc lamps, and, while some have thus been tried on streets and in parks, no regular installations could be cited up to the time the present report went to press. The use of tungsten-lamp street lights on single posts and in clustered standards had begun at the time of the last report and was referred to therein. Later examples show how extensive has since been this development. A special report of the National Electric Light Association of June, 1911, gives a list of no fewer than 84 cities in which ornamental posts for incandescent street lighting had then been installed. The example was cited of Atlanta, Ga., where the system illuminated a length of street approximately 13,000 feet and included 239 handsome low posts, each carrying five 100-watt tungsten lamps in opal-glass globes.

At Warren, Ohio, up to about 1909-10, the city streets were lighted with open arcs, and the municipality then considered changing to inclosed, but the local company intervened with some suggestions and demonstrations as to tungsten posts, and finally a new contract was made for series tungstens on a 10-year basis, the company to install and operate the entire system. It seemed only natural that a great incandescent lamp manufacturing center should thus use its own product. The installation is divided into the residential and the downtown systems. In the former there are 355, 90, and 175 street series lamps of 40, 60, and 80 candlepower, respectively. All the units are equipped with reflectors and are suspended by gooseneck brackets from wooden poles arranged in a straight line along one side of each residential street. In the spacing of these units, in the residential district one lamp is located at each street intersection and the intervening distance between corner lamps is divided so that the spacing is as uniform as possible. This varies, however, from 100 to 300 feet in the different streets, depending on the traffic demands and to some extent on the foliage of the shade trees. The lamps are 14 feet above the pavement, and they are suspended 3 feet beyond the curb line over the road. The illumination in the residential districts is highly satisfactory and is far superior to that furnished by the former open arcs. The lighting of the downtown streets is ornamental. Sixty-two 3-lamp iron standards, each supporting 2 pendant lamps and 1 upright, are employed on the principal business streets, while around the central park 22 single-lamp standards are located. At the entrance of the courthouse, on the north side of the park, two 5-lamp standards are situated, one on either side of the approach. All upright lamps (except nineteen 60-candlepower lamps on the single-lamp standards) are rated at 80 candlepower and are surrounded by 14-inch globes, while 12-inch globes are used on the 40-candlepower pendant lamps. The spacing of the 3-lamp standards is uniform in each street, but varies from 65 to 75 feet in different streets; that of the single-lamp standards is from 65 to 85 feet. The corner standards at street intersections are set where the street lines extended meet the curb lines; thus there are eight of these standards at each intersection.

Each ornamental standard is anchored to a 2½-foot cube of concrete, the center of which is placed 18 inches back from the curb line in the business streets, thus allowing the outside pendant lamp to be hung directly above the face of the curb. The wiring of the standards is all underground. The contract specifies the following prices per annum to the lighting company for maintaining the three sizes of lamps in the two systems and under the two operating schedules. The cost of installation is taken care of in these prices.

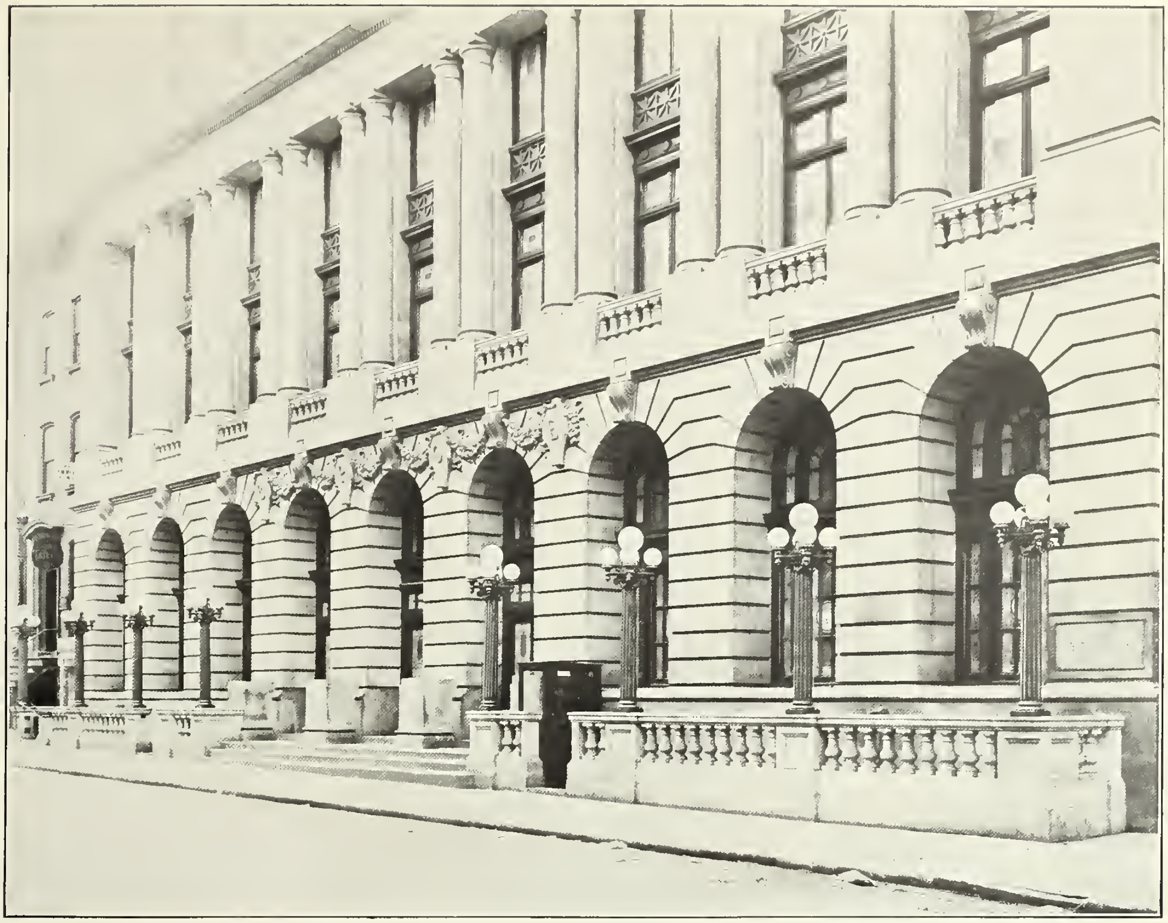
SIZE OF LAMP.	ORNAMENTAL.		Residential, all night.
	All night.	Midnight.	
40 candlepower	....	$12.00	$13.50
60 candlepower	$19.50	14.50	19.50
80 candlepower	23.00	18.00	23.00

Included in the cost of installation, that of the standards, bases, conduits, and wire was as follows: 5-lamp standards, $40; 3-lamp standards, $36.50; 1-lamp standards, $30. These figures are based on one standard of each kind, exclusive of lamps, globes, sockets, etc. The 3,065 feet of steel-armored cable cost 36 cents per foot and an additional 5 cents per foot for laying. The lead cable, of which there was 4,550 feet, cost 21½ cents per foot, and the bases for the 86 posts were estimated at $3.50 each. The fiber conduit laid cost 51 cents per foot, and the total cost of the globes was approximately $1 each.

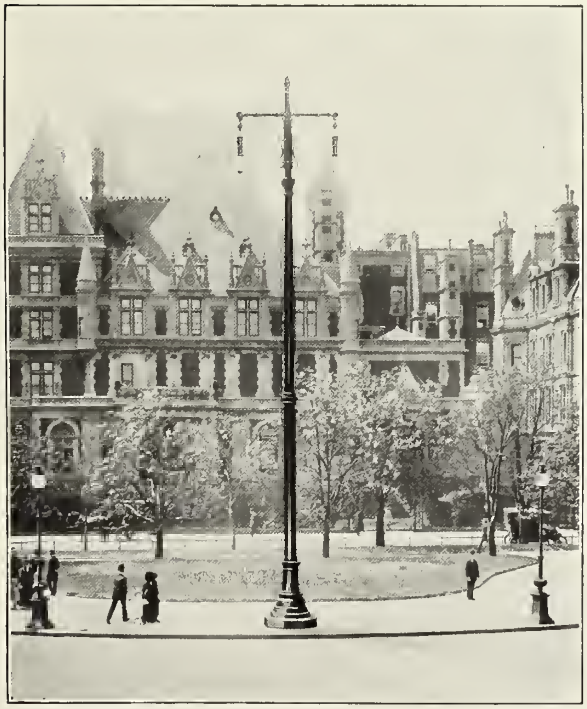
In the old open-arc lighting system there were 161 units, consuming 500 watts each and operating on 9.6 amperes. Seventy-one of these lamps burned on all-night schedule and the remainder till midnight, in the former case the city paying the central station $80 each and in the latter $55 each a year.

In 1911 a number of concrete posts for tungsten lamps were set up at Ann Arbor, Mich., in the effort to secure somewhat cheaper construction. The cost was $7.47 per pole. The posts are 25 feet long, 8 inches in diameter at the base and 5 inches at the top, and are reinforced with four ⅜-inch steel rods, one at each corner. Complete, the posts weigh 1,185 pounds each. Six inches from their tops single arms or buck arms are cast into the concrete, 1½ by ⅝ by 18 inch steel angles being used. These arms are bored for ⅝-inch bolts, which support the insulators carrying the line wires. Nineteen feet from the butt of the pole, three ½-inch bolts are cast into the concrete for carrying the lamp bracket. The posts are set 5 feet into the ground, bringing the lamp 12 feet above the curb. On each post is stenciled the number of the lamp and its circuit. The wooden forms required for the construction of these poles cost $200 to build, $155 of which was for lumber and mill work. A concrete mixture of one part Portland cement, two parts sand, and four parts ½-inch crushed limestone was used, the cement being mixed wet and poured and troweled in the form.

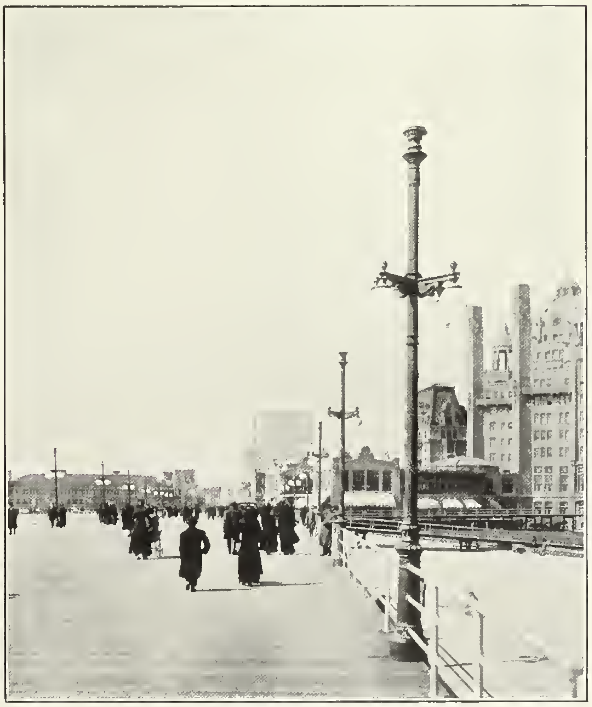
Another treatment of the "ornamental street lighting" idea, which is more or less typical of this kind of work, is found at Des Moines. The city agrees to pay for the operation of the top lamps in the clusters on the curb-lighting posts from dusk to midnight, the energy used between midnight and dawn by the lamp being donated by the Des Moines Electric Co. Up to the close of 1912 the electric service company, assisted by "booster" organizations, had put in position in Des Moines 440 curb lighting posts, each supporting five 100-watt tungsten lamps in translucent white-glass globes. One of these globes surmounts the post and four are suspended from brackets. The original arrangement was that merchants or abutting property owners should pay the electric service company for posts and equipment at the rate of $60 for each post, with a monthly operating and maintenance charge of



1. FIVE-LIGHT CLUSTER LAMP PILLARS, ELKS CLUB, NEW YORK CITY.



2. TWO ALBA FLAMING LAMPS, 45 FEET ABOVE SIDEWALK, PLAZA, FIFTY-NINTH STREET, NEW YORK CITY.



3. LAMP PILLARS ON BOARD WALK, ATLANTIC CITY, N. J.

(Face p. 142.)

$5.80 per post. In the event of failure to pay the monthly charge the electricity was cut off.

The retail merchants then started a movement to cause the city to take over the 440 electroliers and pay for their operation and maintenance as street lighting. They were not successful in securing all they asked for, but they did obtain a substantial reduction as the result of an arrangement by which the merchants, the city, and the company agreed to share the burden. The initial cost of the installation of new posts, $60, remains as before. However, the city agrees to pay $12 a year for the lighting and maintenance of each top lamp from dusk until midnight. The cost of this service from midnight until dawn is assumed by the company. The merchants agree to pay $43.68 a year, or $3.64 a month, for the operation and maintenance of the four other lamps from dusk until midnight. The posts are spaced 44 feet apart, so that the cost to each merchant having 22 feet frontage is only $1.82 a month. The electric service company's total revenue from each post, operating the lamps as related, is $55.68 a year. In order to get revenue to pay for the top lamps on the curb-lighting posts, the city discontinues entirely the ordinary street-lighting arc lamps at street intersections in the districts affected. After midnight the street lighting is thus confined entirely to these top lamps, which are thought to afford sufficient light for the purpose.

Chicago is a striking example of this newer development in street lighting. Taking figures published in September, 1912, it would appear that 3,000 privately owned street-lighting posts were then being operated by the Commonwealth Edison Co., which has devoted special attention to securing this class of contracts in outlying business centers. A load of about 1,200 kilowatts was thus connected and in use for this kind of public illumination, the cost of which was defrayed by abutting merchants. Of the total number of posts, 85 per cent were installed under the company's regular two-year contract, by the terms of which the central station company erected and maintained the installation, operating it a given number of hours daily, for a fixed sum, collectible weekly from the individual merchants or from the neighborhood business men's associations. About 500 posts were served on a meter basis, the customers installing their own equipment and purchasing energy from the Commonwealth Co. at a fixed kilowatt-hour rate.

The rates for this ornamental street lighting, under the standard two-year contract, are as follows for posts each carrying a single 250-watt tungsten lamp or four 60-watt tungsten lamps:

	Per lamp-post per week.
Dusk to 10 p. m. 6 nights and dusk to midnight 1 night per week	$1.75
Dusk to 11 p. m. 6 nights and dusk to midnight 1 night per week	1.85
Dusk to midnight 7 nights per week	1.95
Dusk to 1 a. m. 7 nights per week	2.10

For posts equipped with five 60-watt lamps the schedule is:

	Per lamp-post per week.
Dusk to 10 p. m. 6 nights and dusk to midnight 1 night per week	$2.00
Dusk to 11 p. m. 6 nights and dusk to midnight 1 night per week	2.13
Dusk to midnight 7 nights per week	2.25
Dusk to 1 a. m. 7 nights per week	2.37

These charges are payable weekly and are subject to a discount of 25 cents per post if paid within three days from date of bill. After the original term of the two-year contract has expired, the service may be continued, if desired, at a cost of 66.7 per cent of the above-listed rates. Lamps are switched on and off at the specified hours by the company's patrolmen. Changes in posts or wiring are made at the expense of the customer. In outlying districts the lines of the Commonwealth Edison Co. follow the alleys, and to reach the street-lighting installation taps are brought across the customers' premises to the curb, a group of three or four posts being served in this way from each tap.

It may be noted that Chicago exemplifies the use of various styles of post, including concrete, also the single-unit type with one lamp, with a decided tendency toward the cluster fixture.

Kansas City may also be quoted as an example of work in this direction. Seven miles of its downtown streets are lighted by 1,500 trolley-post brackets, each carrying three 150-watt tungsten lamps in a single clear-glass inclosing globe, besides one 16-candlepower carbon unit pointed upward. For several years a more ornamental fixture has been sought, and as the result of competitive exhibits an official design has been selected. To this pattern all installations are required to conform in order to receive a city permit. The patterns have been acquired by the city, so that the manufacture of the posts is thrown open to all. While of course local property owners can in no way be forced to substitute for their present fixtures posts of the newer design, it is the plan that, as from time to time new installations are erected or old ones replaced, these approved patterns shall be employed, with the result that ultimately a uniform ornamental lighting system will be in use throughout the entire city.

The designs accepted from the competitive exhibits submitted include both complete 5-lamp standards and bracket arms for trolley posts. The standards to be used on streets without trolley lines are of slender and graceful proportions and carry five upturned 100-watt lamps 13 feet above the sidewalk. The post base is 13 inches in diameter, and the distance measured across the pairs of 10-inch globes is 2 feet 10 inches. Delivered at the curb and completely equipped, these 5-lamp standards cost $50 each. This outlay is met by the abutting property owners. The Kansas City Electric Light Co. makes the installations and is paid by the city $32.50 per post per year. The selection of the designs was made by a committee representing local improvement associations, the Municipal Art League, and city officials.

A pleasing modification or variation of the low-post plan has been afforded in one or two cities, of which Minneapolis may be cited as an example. Its downtown streets have been rendered attractive during daylight hours by the greenery of flower baskets, which grace a number of the curb-lighting posts. This ornamentation of the tungsten standards is due to a general movement, encouraged by the Minneapolis Civic and Commerce Association, to decorate the business section with "hanging gardens," window boxes, flower baskets, etc. A special container is arranged to fit over the top of the 5-lamp standard, and in this flowers, ferns, and trailing vines are planted, producing a charming effect. The cost of equipping such a post is about $6 the first year and $4.50 annually thereafter. This outlay has in each case been defrayed by the abutting property owner or tenant. In the Minneapolis instance these bits of green which fleck the downtown streets in summer time have given to the town the appropriate title of "The City of Hanging Gardens."

Many general questions have naturally been involved in the change to incandescent street lighting, outside of the technical problems. Those who have made such installations have met with frequent objection raised by the storekeeper at the corner liable to payment on a curb-foot basis for both his narrow front on the main street and his longer front on the side street. The difficulties thus created proved almost fatal to the plans for tungsten curb fixtures at Great Falls, Mont., where the corner-property objectors refused to go into the agreement. An adjustment was finally secured, however, by installing 32-candlepower lamps in the alleys behind the stores, and charging these lamps to the mid-block occupants on the same curb-foot basis as in front. The conduits for the curb fixtures are fed through overhead lines in the alleys adjoining the main street, so that it was a simple matter to install 32-candlepower graphitized carbon-filament lamps and reflectors on wooden poles. The presence of these alley lamps has also a positive police value in preventing depredations on merchants' stores from the rear. Under the arrangement, the cost of erecting and operating the lamps is borne on a footage basis in which both front street and alley frontings are counted equally, the discrepancy between the corner and mid-block occupants being reduced to a point where the former were all satisfied to come in. Eighty posts, each carrying four 60-watt till-midnight lamps and one 100-watt all-night lamp, have been installed. The posts are of an elaborate type manufactured locally and cost $135 each, completely installed. The Great Falls Electric Properties operate the entire system, including the alley lamps, at the rate of $6 per curb post per month. There are two of the alley lamps to each block, located at points one-third the distance between streets. Under a Montana statute, the cost of building and operating this ornamental lighting system is borne one-half by the city government, one-third by the abutting owners and tenants, and one-sixth by the street railway company, the latter being required by law to contribute this amount to the lighting of streets traversed by its cars.

The tungsten lamp.—The report of 1907 bore evidence to the place already made for itself by the tungsten, or as it is now quite generally known, the "Mazda" lamp. Its inroads since 1907 upon the field previously occupied by the carbon-filament lamp have been remarkable; as exemplified in one respect by the data given in preceding pages as to its adoption for street lighting, where, however, it was in competition with the old-fashioned arc lamp. A very rapid development of interior and domestic electric lighting by central stations has gone on throughout the census period, due in part to the development of the incandescent lamp and in part also to the increased economy of central station service and the lower price of current. Of course, the tungsten lamp is by no means the only one in use, as will be shown, but it has been the leader in improvement, and a few of its advances may be referred to briefly. The pressed tungsten-filament lamp was introduced commercially in this country about 1907, the filament being then made by squirting the material through a die. The stronger drawn-wire filament soon followed in 1910, being made from tungsten wire drawn from bars of the pure metal. A reduction in the size of the glass bulb was made possible by improvements in methods of manufacture, and there was a great decrease in the depreciation of candlepower throughout the life of the lamp, due to lessened blackening of the bulb. A higher vacuum was obtained by chemical methods, the use of a chemical making it possible to obtain a much better exhaust than with the pumps alone. The efficiency of representative types of tungsten lamps rose as follows:

YEAR.	Efficiency—Watts per candle.	YEAR.	Efficiency—Watts per candle.
1907	1.25	1911	1.18
1908	1.25	1912	1.15
1909	1.25	1913	1.12
1910	1.20		

At the Cooperstown, N. Y., convention in September 1913, of the Association of Edison Illuminating Companies, large tungsten lamps from 350-candlepower to 5,000 candlepower with chemical "vacuum getters"—such as nitrogen gas, upon which considerable antecedent experimental work had been done—were exhibited for the first time, having the low record consumption of 0.5 watt per candle in the largest units.

In the period 1907-1912 the tungsten lamp rose from 10 per cent of the total American output of incandescent lamps to 39.94 per cent, while carbon-filament lamps fell from 93.27 per cent to 25.47 per cent. In the same period the approximate average candlepower of all incandescent lamps rose from 19 in 1907 to 29 in 1912.[1] The price of the lamp went down in still greater proportion, the 40-watt lamp being listed at $1.50 in 1907 and at 45 cents in 1912. The number of all lamps sold in the United States in 1912 is placed at 90,000,000, being an increase from 1907 to 1912 of 41.7 per cent.[2] The proportions of carbon and tungsten filament lamps have already been noted. But graphitized carbon-filament lamps represented no less than 33.59 per cent of the total in 1912, the tantalum metallic-filament constituting only 1 per cent. It is interesting to note in this connection that under date of May 1, 1913, the Treasury Department of the United States issued an order covering instructions for the use of incandescent lamps which set forth that after that date "gem" or graphitized lamps of any description would not be used, thus adopting the tungsten lamp exclusively for the purposes of the National Government.

In the earlier pressed-filament process and in the initial stage of the tungsten wire-drawing process, it was commercially impossible, on account of the high price that would result from a sufficiently close selection, to make filaments of the exact amperage desired. It was necessary, therefore, in lamps intended for series-burning service, to make them as nearly as possible of the correct amperage, photometer them to determine the current necessary to produce the correct efficiency, and then to sort them out into narrow ampere ranges. Only lamps of the same ampere range were suitable to burn in series together. It was necessary, therefore, to use extreme care that each customer always received lamps selected for his range of service. In cases of errors in photometry, poor sorting or accidental mixing, customers received lamps of widely different amperages, which when burning in the same series naturally produced ununiform candlepower and variable, short lives. Improvements in the wire-drawing process have made it possible to select wire that will produce lamps of approximately exact amperages. Hence it is possible now to have, instead of a range of amperages for each size of lamps, a single current rating for each size. For instance, in the case of the 6.6 ampere, 40-candlepower street-series lamp, where it was formerly necessary to have ampere ranges corresponding to 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, and 6.9 amperes and always to supply each customer with lamps from a single one of these ranges, it is now possible to make all lamps of this size almost exactly 6.6 amperes. This improvement applies to all lamps intended for street-series service and series-burning sign service, and has been productive of greatly improved results in both cases. It has also made possible the adoption of only five standard amperages for street-series circuits, namely, 3.5, 4.5, 5.5, 6.6, and 7.5 amperes. All central station companies are adjusting their street-series lighting circuits to one of these standard current values.

Electric signs.—One of the most interesting developments of recent years in the incandescent-lamp field has been the growth of sign lighting. The use of the electric sign is universal, and the more prominent thoroughfares in every American city of any size or pretensions to activity are ablaze after dark with large and small signs, many of them being of the "flashing" type, and some of them being built up with several thousand lamps. The estimate was made in 1912 that there were at that time installed on central station circuits no fewer than 80,000 electric signs, which, at an average of 100 lamps, would represent 8,000,000 lamps. These signs for commercial purposes have been supplemented by a large number in a special class, of the "slogan" type. Cities in all parts of the country have placed signs of this character near the railroad track, or in other conspicuous places, so as to catch the eye, emphasizing the desirability of the city as a business or manufacturing center or as a home. The sign of this character at Toledo, Ohio, is the largest of its kind in the world. It flashes an express train at full speed, then a lake steamer, and finally advises the traveler that "You can do better in Toledo." It weighs 25 tons and is 75 feet long and 68 feet high. There are 7,000 tungsten lamps of 10 watts each in this sign. As a usual thing, the lamps used in signs are smaller and of lower candlepower than those employed for illumination.

Display illumination.—A further development in incandescent lighting of this nature has been seen in its employment as a means of outlining large edifices at night, either permanently or for special occasions. Perhaps the most conspicuous example that could be cited was the illumination of St. Patrick's Cathedral, New York City, on the return from Rome, in January, 1912, of Archbishop Farley after he had been raised to the cardinalate. The pride of the citizens and the joy of the parishioners found admirable expression in one of the most beautiful nightly spectacles the city has ever seen. The lighting plan included all of the vertical and horizontal lines, the arches, windows, buttresses, and doors, as well as the two great spires and the crosses surmounting them, 340 feet above the asphalt of Fifth Avenue. In addition, there was outlined over the main entrance in various colored lamps the coat-of-arms of the cardinal, a shamrock with two eagle heads to the left and two doves on the right. A special system of cables was used extensively on the spires, and there, during the bitterly cold weather, the steeplejacks working on the job were clad with electric heating-pad jackets in circuit with the lights, to keep them warm. Some twenty-seven thousand 8-candlepower lamps and 20 miles of wire were required in outlining the building. A mile of independent low-tension feeders was run underground from the New York Edison Co.'s substation at Fifty-third Street and Sixth Avenue to and around the cathedral to supply the energy. Surrounding the cathedral were arranged twenty-four 5-lamp gilded tungsten standards equipped with 150-watt lamps. By means of control from the substation the illumination was brought up gradually from a dim glow to a full blaze of glory. Special lighting was also arranged temporarily for the interior of the cathedral. Forty-watt tungstens replaced the two thousand and one hundred 16-candlepower carbon-filament lamps, and the seven great chandeliers, 130 feet above the floor, five in the nave and one in each of the transepts, were lowered for greater effect. The lamps around the columns were also changed. The sanctuary illumination was modified to accentuate the beauty of the marble altar and reredos, the altar itself remaining untouched.

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[1] Presidential address, Millar, Illuminating Engineering Society, September, 1913.

[2] Report of Lamp Committee, National Electric Light Association, June, 1913.

VAPOR LAMPS.

Vacuum-tube lamps of various kinds were noted in the 1907 report, and they have since then made a place for themselves in the art which would apparently indicate their ability to survive, in competition with other illuminants, or in association with them, as exemplified in the Allegheny County Soldiers' Memorial at Pittsburgh. This fine building, somewhat suggestive of Grant's Tomb or that of Halicarnassus, cost $1,500,000. Its lighting cost about $60,000, or only 4 per cent of the total, but is a very large part of the decorative scheme. At night the façade is illuminated by the light of the mercury vapor tubes inside, with marvelous effectiveness. Within, tungsten lamps are used very brilliantly in the corridors. The main room is the auditorium, 110 by 120 feet and 65 feet from the center of the floor to the ceiling. It seats 3,000 persons. Here all lighting is indirect through an elaborate glass septum, divided into panels. Tungsten lamps of 50.5-kilowatt consumption radiate more than 50,500 candlepower. The 444 dim stars in the ceiling are represented by 25-watt carbon lamps; the bright stars are represented by 129 tungstens of 40-watts. These lamps are carried in plaster rosettes helping to accentuate the larger elements. The central panel is outlined in rosy pink by the vacuum tube which incloses it. There are nine centers which consist of circular panels of rich pierced plaster ornament, above each of which are suspended two 18-ampere flaming arcs. A group of glass sashes is arranged around each of these arc panels and forms a series of geometrical surfaces. Each of the main rectangular panels, comprising a flaming-arc center and its group of sashes, is framed by a nitrogen vapor tube, with a reflector that projects the light through an encircling slot, so that each panel is banded by rose-colored light. Glass panels are located close to the side walls, one over each window, and over each is a parabolic reflector containing a 400-watt mercury vapor lamp. The light from these sources is directed against the walls of the room, and through the windows, and is so softened by the panel glass as to acquire a pale sky-blue tone. The effect of this ceiling may perhaps be compared with that which would be furnished by a vast luminous canopy in Persian rug tints. Fixtures would have cost as much, but could not have given any such illumination. The lighting is so controlled that any feature can be used singly, and the qualities of moonlight, dawn, early morning, high noon, and sunset are all obtainable at will. In all, 30 different effects are available. Five systems of electric lighting are employed for single effects or in a harmonious whole. The people who did this were not afraid of color and knew how to use it. As Mr. Henry Hornbostel, of the firm of architects responsible for the design of the building, has said, the time has come for abandoning certain traditions relative to illumination and for establishing new ideals, especially concerning color combinations.

The quartz lamp.—A newcomer of the period has been the quartz mercury arc lamp, which is distinguished from its immediate predecessor, the glass mercury arc, by the fact that, by reason of the change in the material of the tube itself, a considerably larger amount of energy can be concentrated in a given space for illumination, with a higher potential drop per unit length of tube, a higher mercury vapor pressure, and a higher temperature. All this leads to a greater efficiency of light production. The greater concentration of energy is made possible by the employment of quartz, a material of far higher melting point than even the most refractory glass that can now be obtained, as the envelope. The two classes of lamps are similar in utilizing the principle of the passage of an electric current through mercury vapor to produce light, but they differ not only in the character of the container but in the pressure of the vapor, the temperature of the arc, the color of the light, and other incidental features. Quartz as a refractory substance for vessels and tubes in laboratory work has been used for a number of years, but it is only the advent of the high-pressure mercury vapor lamp that has made a demand for it on a large scale. With a mercury vapor lamp operating at a pressure of one atmosphere, it has been calculated that the temperature at the center of the arc is between 4,000 degrees and 6,000 degrees centigrade.

Ordinary lead glass will soften at about 300 degrees. The quartz used in these new lamps is made in Europe by fusing the tubes from rock crystal. It is extremely hard, being 7 on a scale where the diamond rates as 10. It is transparent and practically colorless.[1] The operation of the quartz lamp on commercial-line circuits from central stations supplying direct current offers no serious difficulties, and lamps are being manufactured for 110-, 220-, or 550-volt direct-current circuits, the 220-volt lamp being the more generally used. The best value of the quartz tube as a light source is given as 0.4 watt in specific consumption of energy per mean spherical candlepower. The color of the light, according to measurement with the Ives colorimeter, is closely the same in average as that of daylight. Some quartz lamps have already been introduced abroad in street lighting, and in this country a number of small street-lighting installations have been made in cooperation with business men's associations, but the field has been narrowed by the absence of lamps that could be operated in series or with an alternating current.

The neon tube.—The last addition to the lighting resources of the central station art is the neon tube of Claude, a French physicist, which has already been exhibited before the central station bodies of this country but has not entered into actual service here. It employs the very rare gas neon, which forms a constituent part of the atmosphere and is now obtained in commercial quantities as a by-product of the preparation of liquid oxygen from air. The ordinary tubes are about 6 meters in length and give 900 spherical candlepower with a specific consumption of 0.72 watt per candlepower. The light is of a warm orange color, entirely lacking in blue rays, just as the ordinary mercury arc is lacking in red rays.

USE OF CURRENT FOR POWER.

The significant fact appears from the returns that while the total central station income from light, heat, and power increased 240.9 per cent in the census period 1902–1912, the number of stationary motors served increased 330.9 per cent and their horsepower capacity 843.1 per cent. This is altogether independent of the large percentage of income derived from the supply of current for street-railway service, already noted. Moreover, while the average gain is very high, it falls extraordinarily short of the gain in some individual states in electric-power work, due wholly to the development of hydroelectric power plants and the incidental transmission and distribution. It is when one turns to the statistics of the two neighboring states of North and South Carolina that the unprecedented extent of hydroelectric development emerges. Going back a dozen years, these two states were utterly undistinguished in the arts of the central station industry and power transmission. Since 1902 the income of central station plants in South Carolina has risen from $387,010 to $4,499,800 in 1912, a percentage increase of 1,063. In addition, the water-wheel capacity has increased 1,614 per cent, the station output 1,836 per cent, and the stationary-motor capacity 2,274 per cent. North Carolina rivals these figures in some respects, and, astounding as it may seem, eclipses them in others. The income there rose from $250,133 in 1902 to $1,458,786 in 1912, which is only 483.2 per cent for the period, an average of 48 per cent per annum, but the water-wheel capacity increased from 1,920 to 49,951 horsepower, or 2,502 per cent, and the capacity of stationary motors rose from 950 to 32,830 horsepower, or 3,356 per cent. It is doubtful if there is anything to equal such data in present-day development in America. There can not be many industries expanding at an average rate of 335 per cent per annum for a term of 10 years. It could hardly be expected as within human probability that such rates of advance could be maintained, especially in these two states. And yet, in September, 1911, Mr. G. K. Hutchins, of the Columbus, Ga., Power Co., in a discussion of this subject, reported a large percentage of cotton mills still operated entirely by steam power; while Mr. F. P. Catchings, of the Georgia Power Co., stated that only about 25 per cent of the cotton mills in North Carolina were driven wholly by electricity.

Operation of textile mills.—Among the distinctive features of the electric drive mentioned by Messrs. Hutchins and Catchings is the great flexibility it introduces into all departments of the mill, thus permitting the various processes to be kept balanced, and affording economical means in any department for overtime work which might be required for the finishing of special orders. Not only does the constant and uniform speed serve to secure a better quality of product, but experience has shown that there is obtained a substantial increase in product, conservatively estimated at an average of 10 per cent. The textile mill affords a very satisfactory demand for energy throughout its running hours, and furnishes an attractive day load for any central station of sufficient size to handle this class of business. Five textile mills in which the average of maximum demand was taken for a 12-month period showed a ratio of demand to the motor rating installed varying from 71 to 96 per cent.

Cotton ginning.—In like manner the cotton gin has loomed up as a desirable load for southern plants. In general, electric companies in the South and Southwest have avoided cotton-ginning loads on account of their comparatively heavy demand during only a few months in the year, overlapping the winter lighting season. The cotton-ginning season usually begins in August or September and lasts through December, running much of this period 24 hours a day, the latter part coming at a time, however, when the capacity of generators is needed for the evening peaks. In the case of a 65-horsepower cotton gin at Coalgate, Okla., motor-driven by the local central station, not only does the electric company consider this good business, but the gin, though in the midst of a coal-mining section, has been able to reduce its total operating expenses from 50 cents down to 30 cents per bale, with energy at 4 cents per kilowatt hour. This gin has a capacity of about 1 bale each 10 minutes when running continuously. With electric drive the heavy boiler operating and upkeep costs have been eliminated, together with the boiler-room force, leaving only one gin-stand man and one packer to operate the plant. The gin usually begins operation August 15 and runs until about the first of the year. The heaviest cotton-ginning season is near the middle of this period, when the gin is sometimes run 24 hours per day. At other times the ginning load by agreement is kept off the peak period of the lighting plant, being operated principally during daylight hours.

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[1] The Mercury Vapor Arc Lamp, Trans., Illuminating Engineers' Society, Pittsburgh, 1913, Evans.

Special uses.—These details as to one industry might well serve as an example or illustration of what is happening all along the line in the operation of the innumerable industries of the United States, and it is in reality only possible here to refer to such typical applications, where a whole industry is affected, or to special cases where the electric motor makes possible and economically successful that which could not previously be attempted. An admirable presentation of the value of the power load for central stations was made in September, 1911, before the Vermont Electrical Association by Mr. F. M. Kimball, who outlined the value of some of the special uses to which electrical energy is being put, as follows: For driving printing machinery, because of its qualities of cleanliness, variation in speed, safety, and economy; for running elevators, where electrical devices for securing control in speed and direction of movement are more simple and effective than when any mechanical drive is used; for operating woodworking machinery, requiring essentially a high rate of speed; in stores, markets, and jewelry shops, and by opticians; in shipyards and erecting works, in conjunction with machine tools that can be carried to various portions of floor or yard; for driving fans and exhausters, bellows, etc.; by bakers and confectioners, with whom perfect cleanliness is highly desirable; in pumping water for irrigation; in lumbering operations, enabling portable mills to be operated anywhere on the cut; in small refrigerating apparatus; on docks, to move and load merchandise; in building operations, to raise material; in cash-carrier systems in stores; for driving laundry machinery; in hotels, etc.; for quarry work, in drilling. The capacity of motors Mr. Kimball placed as not far from 1,000,000 horsepower in the United States alone.

Large users of electric power are indeed increasing rapidly in number, sometimes in new fields and quite often in old. In the summer of 1911, for example, the Worcester (Mass.) Pressed Steel Co. contracted with the Connecticut River Transmission Co. to supply current for 600 horsepower in motors, with a 24-hour load, using 3-phase, 60-cycle, 13,000-volt current, lowered to 500 volts. A large number of other and more extensive steel-plant installations could be cited. Mining operations by electricity are exemplified by the Empire District Electric Co., of Joplin, Mo., giving service the same year with 2,300-volt motors in no fewer than 125 different mines, for pumping, hoisting, and other operations; the company having at that time 37,000 horsepower of generating capacity for all services and a motor load of not less than 16,500 horsepower, all energy being sold on a horsepower basis and on a demand schedule. A somewhat analogous service is the operation of oil-well pumps by central stations. Near Folsom, W. Va., a number of motor-driven oil wells have been in operation several years. Central station service has been introduced among the wells of the Kern River and Los Angeles fields in California, where more than 300 motors were at work in 1912, resulting in a saving of half the former cost of steam drive. On the basis of 233 wells served the saving in operating expenses was nearly $120,000 per annum.

Pumping water.—Water pumping for large and small communities is another of the newer fields of importance. For example, the Niagara River has been made to pump itself electrically for the water supply of the city of Niagara Falls, N. Y. Motor-driven centrifugal pumps lift the water from the seething river and deliver it to settling beds, from which it passes to the street mains. The plant in 1911–12 was capable of delivering 13,000,000 gallons per day. Some waterworks figures were given before the Michigan Electrical Association in 1911 by Mr. F. D. Spencer, of Cheboygan, who cited a number of examples with the data of electrical consumption for 1,000 gallons pumped. One company operating a triplex pump driven by a 35-horsepower motor and pumping against 100-foot head reported an average consumption of 700 watt hours per 1,000 gallons pumped. Another company operating a motor-driven deep-well plunger pump reported a consumption of 1,333 watt hours per 1,000 gallons pumped against a head of 120 feet. Another plant reported a consumption of 1,220 watt hours per 1,000 gallons pumped by a motor-driven deep-well plunger pump lifting 110 feet.

At Coalgate, Okla., the water supply for the 4,000 population is lifted from 250-foot wells by one 50-horsepower motor-driven compressor supplying air-lift pumps and one 15-horsepower deep-well pump.

The reservoir level is maintained by a 25-horsepower centrifugal pump capable of delivering 300 gallons per minute. Tests made by Mr. H. L. Reager, manager of the local central station company, show that about 1.25 watt hours are required by the deep-well pump for every gallon lifted. As this means a considerable saving over the air lifts, the town decided to replace the latter by deep-well pumps. The pumping station is 5 miles from the town and the powerhouse, and the attendant who takes care of the pumps augments his income by farming. All of the motors are 2,300-volt machines. Ordinarily the pumps are operated from 3 p. m. to 5 p. m. and for several hours in the early morning beginning at 12 midnight. The town pays 4 cents per kilowatt hour for its pumping service, from which the central station derives an income of about $500 a month.

The water of Webb City and Carterville, Mo., is similarly supplied by motor-driven pumps. The joint waterworks company serving the two nearby communities has installed five double-plunger deep-well pumps, each capable of delivering 500 gallons per minute from the 300-foot depth and driven by 25-horsepower 25-cycle motors. The pumps discharge into a 5,000,000-gallon reservoir. Energy for the waterworks is purchased from the system of the Empire District Electric Co. at the rate of $1.25 per month for each horsepower connected, plus 1⅛ cents per kilowatt hour consumed.

The extreme flexibility of motor drive is again shown by a Louisville installation which furnishes water from a well of special quality to a brewery 3,040 feet distant. This brewery is located on the dry bed of Ballards Creek, from which its supply was formerly obtained, but, with the use of the creek water for other industrial purposes at points above, recourse was had to the well above mentioned, the water of which is found especially valuable for use in the brewing plant. This water is raised by an air lift and is then conveyed 3,040 feet from the well to the brewery by a 15-horsepower, 3-phase induction motor-driven centrifugal pump capable of delivering 200 gallons per minute. Electric service is supplied from the lines of the Kentucky Electric Co.

The Kansas City Electric Light Co. gives service under contract to Armour & Co. in pumping 18,000,000 gallons of water per 24 hours for the latter's local packing plant. For several years the electric company furnished the packing plant 6,000,000 gallons daily from a motor-driven pump on a barge anchored in the Kansas River near its generating station. The permanent installation for delivering the larger quantity comprises a 500-horsepower, 6,600-volt, 25-cycle motor, driving a single-stage centrifugal pump. This equipment is located in the basement of the company's operating station. The pump delivers into a 30-inch pipe leading to the packing plant, against a hydrostatic head of 111 feet. This water is used principally for cooling purposes in the refrigerating plants, and is required in nearly uniform quantities throughout the 24 hours.

Before leaving this topic it is only right to note that the huge cofferdam around the wreck of the battleship *Maine* in Havana Harbor was emptied by three large centrifugal pumps each driven by electric motor and mounted on a barge. The electrical energy for this unique pumping service was furnished through submarine cable by the local Havana Lighting Co., an American institution.

An unusual pumping performance is that of marsh drainage along the Illinois River. The Pekin and La Marsh Drainage District consists of about 2,500 acres of land along the Illinois River, near Pekin, protected from overflow by a dike on the river bank running back to the bluffs at both ends of the district. This area is in charge of drainage commissioners, who drain the land and keep it in condition for cultivation by pumping the water from the inclosure over the dike into the river. Thus at all stages of the river the land is available for agriculture. The first pumping plant in connection with this drainage system was driven by steam engines, but, as the cost proved too high, the engines were superseded by gas engines supplied from a producer plant. After a year's service the gas-engine equipment was in its turn replaced by electric motors supplied with energy from the local central station companies.

Suction dredging.—In the Susquehanna River there accumulate large deposits of anthracite washed down by every spring freshet, the greatest deposits occurring at Plymouth and Northumberland. These are reclaimed for use by the local central stations. At Plymouth a barge equipped with motors of 190 horsepower has a centrifugal pump which sucks coal from the bed of the river and forces it with the water through a long pipe line to the shore, where the coal is dumped. The pump can suck up 50 tons of coal an hour.

Another kind of river pumping is exemplified at St. Louis, where in April, 1912, work began on a dike 40 feet high and three miles long to protect the lower sections of East St. Louis against the inroads of the Mississippi River. With current taken from a local plant through a submarine cable, a dredge with an 800-horsepower electric motor handles 15,000 cubic yards of wet material per day, sucking it from a maximum depth of 35 feet and lifting it to the extreme height of the dike wall. The pumping dredge is equipped also with other apparatus including a 250-horsepower rock-cutting machine electrically driven.

Flour milling.—The operation of flour mills has become a large part of electric-motor application, with notable economy and increase in efficiency. In 1879 the famous Queen Bee flour mill was built at Sioux Falls, S. Dak., at a cost of $500,000, but was shut down a year later on account of transportation troubles. It stood idle until 1912 when it was found that motor drive for it with central station current was possible and profitable. When first operated with an ordinary 800-horsepower water-wheel plant its capacity was 800 barrels of flour per day. Now, with only 485 horsepower of electric motors, its capacity is 1,200 barrels.

Sewage disposal.—Oklahoma City, Okla., in 1912, contracted with the Oklahoma Gas & Electric Co. for 130 horsepower to be used for the electrolytic disposal of the city sewage. A 75-horsepower purification plant has been installed in the Packingtown district. The scheme of sewage purification used is similar to that at Santa Monica, Cal. There would appear to be a large, wholly new field of central station activity in this direction.

Street paving.—The city of Leavenworth, Kans., began to repave a prominent business street, and let a contract for that purpose to a paving firm, which used a steam engine to run the paving machinery. Complaints from residents on the street soon followed on account of the smoke, dirt, and noise from the engine, and the Leavenworth Light, Heat & Power Co. finally induced the contractor to rent a motor for the power service. A 15-horsepower motor to run the paving machine was mounted on a wagon, the machine and wagon being moved three times a week; and as the company's lines were on the street where the paving was being done, connection to the service wires was easily changed, the meter and starting box being carried on the wagon with the motor. As the use of the steam engine had caused some delay, working nights was suggested to the contractor, and twelve 100-watt tungsten lamps on portable poles were installed to furnish light for the night work. The contractors were much gratified with the change to electricity.

Wood working.—The introduction of central station energy into wood-working plants has often proved difficult and is a subject of much discussion. It may therefore be noted that a large stave mill at Galveston, Tex., which formerly burned its refuse in its own 100-horsepower steam plant, is now operated by 40 horsepower in electric motors using central station service. This motor drive costs the mill $60 to $65 a month at 4 cents per kilowatt hour, while it sells to the local gas company the refuse formerly burned, for $1.15 per ton delivered, or about $150 per month. The gas company utilizes the oak shavings and refuse for fuel in its water-gas plant, replacing oil that formerly cost $400 to $500 a month.

Telpherages.—It has long been evident that one of the seriously neglected fields of central station is that of operating docks, piers, and railway freight yards, many managers not being aware, apparently, that practical "telpherage" systems and other devices are in use whereby package freight, and even bulk material, are handled successfully; thus opening up an enormous demand for apparatus and energy. As an example, the fact may be cited that at New Orleans and Mobile the United Fruit Co. makes use of motor-driven machines of the marine-leg type for unloading the bunches of bananas from the holds of vessels, thus saving much time, loss, labor, and damage in comparison with hand unloading. On some other docks, as noted in previous reports, the overhead telpherage system, as on the New York river fronts, has found adoption.

At the two southern ports named, from an extension boom projecting over the water's edge a 35-foot vertical marine leg is dropped into the hatch of the vessel drawn up to the wharf. Sprocket wheels on the marine leg and stationary portions of the unloader carry a pair of chains 4 feet apart, between which, on cross-bars, is attached a canvas strip so arranged with slack as to form pockets at 3-foot intervals. The four machines at New Orleans have 92 pocket belts, and each is driven by its own 15-horsepower induction motor. These machines have individual equipments for unloading 2,500 bunches of bananas per hour, the bunches weighing from 60 pounds to 120 pounds each. In the hold of the vessel the conveyors are filled from three levels, each loading into every third pocket of the conveyor, the speed of which is, of course, too high to permit filling successive pockets from a single position. After reaching the back or dock end of the conveyor, the pocket-chain passes over a straight roller which discharges the bananas gently onto a moving belt running back to the cars where the fruit is loaded for rail shipment. At New Orleans the Mississippi River level varies periodically by about 14 feet, and the unloaders must accommodate themselves to this variation, as well as be able to reach the hatches of any ordinary vessel. The suspended marine leg is supported from an auxiliary boom hinged to the main boom, so that, by making a jackknife bend, practically any hatch level or distance from the wharf can be negotiated. The manipulation of the booms and hoists and the side travel of the huge machine along the dock front are all controlled by friction clutches on the main conveyor-motor shaft. Within three to five minutes after the vessel's hatches are made ready, the machines can be located in position and unloading begun. The four machines at New Orleans working together can unload 10,000 bunches per hour. Besides expediting the work of unloading and saving labor, the machines effect their most important economy in preventing damage to the fruit. Energy to operate the unloaders at New Orleans is taken through cables and plug connections on the dock from the lines of the New Orleans Railway & Light Co. The machines at Mobile are supplied with energy by the Mobile Electric Co.

In similar manner the New York Edison Co. has entered into contract with the United Fruit Co. to supply current to its steamers when at their docks in

New York, to be used for operating cargo winches and for other purposes. This lessens the amount of steam equipment necessary to be kept in operation and facilitates speedy handling of the cargo.

Ice manufacture.—The manufacture of ice, either in combination central station plants or through the supply of electrical energy to ice factories, has become an important industry. An interesting example of both businesses being carried on under one management is that of the Kentucky Traction & Terminal Co., of Lexington, which takes the condensate from its surface condensers, reboils and filters it, and uses it in making artificial ice. The plant is of 5,000-kilowatt capacity. Besides supplying the local Lexington utilities, the new turbine station transmits 33,000-volt, 60-cycle energy to railway substations at Paris, Frankfort, and Nicholasville, and to combination railway and lighting substations at Versailles and Georgetown. Sixty to seventy-five tons of ice are turned out daily at the central power house, to be sold directly to retail dealers or held in storage against the heavy summer demand.

Another interesting example is the Durham, N. C., Traction Co., with a combination of lighting, traction, and ice-making. The condensation from the engines is sufficient to make 100 tons of ice a day. The water from the reboiler is forced through four coolers and then through a set of three cloth filters. It passes thence through a set of charcoal-brick filters and three batteries of charcoal and silica-sand filters, whence it reaches the pre-cooler. The latter is a double-pipe arrangement in a tank, wherein ammonia is expanded directly, so that the water on its way to the freezing cans reaches a temperature of 40 degrees Fahrenheit, or lower. There is a storage tank which is also piped with coils sufficient to maintain the temperature of the water a few degrees above freezing before it reaches the cans. With a new tank room, 295 cans in the whole system can be produced, making it possible to manufacture 100 tons of ice a day if necessary. The storage room, in which provision is made for 150 tons of ice without stacking, is piped for direct expansion and is insulated with 4 inches of cork covered with cement. The cork is laid in 2-inch tiers, between which is a ½-inch coating of cement, while the cork on the ceiling and floor is laid in asphalt. Ice is handled by means of a pneumatic hoist and hand-operated crane. The steam from the Corliss engine is first passed through a 36-inch self-dumping oil trap or separator, which is said to be effective in removing the oil from the steam. The ice is retailed by the company at the rate of 40 cents per 100 pounds in small pieces, and 30 cents per 100 pounds in cakes. If two cakes are sold at one delivery, the rate is 25 cents per 100 pounds.

Before the Kansas Electrical Association in September, 1911, Mr. W. E. Sweezey, of Junction City, Kans., gave some interesting data as to combination ice plants. He had had over nine years' experience in combination-plant operation and at that time had a 35-ton plant in connection with his station. The same boilers did the work of both plants, the demand of each varying almost inversely as that of the other. The figures of coal consumption submitted show how the sum of the two demands was nearly constant, one increasing almost exactly as the other fell off. The following tabular statement shows the tons of coal burned and the amounts of electricity and ice produced during six typical months of winter and summer.

	June.	July.	August.	November.	December.	January.
Tons of coal burned	670	675	700	580	620	600
Kilowatt hours generated	108,780	111,710	122,500	146,430	162,121	155,160
Tons of ice made	965	1,055	1,050	112	54	32

In the Junction City plant the same engineers and firemen were employed the year around, as the coal burned and energy converted were practically uniform throughout the 12 months. The only extra labor required by the ice plant was for "pulling" the cakes from the cans, which for the 35-ton outfit cost about $5 a day, amounting to about 25 cents per ton of ice. As a result, the average cost of producing a kilowatt hour in summer, when the output was decreased by 33 per cent, was almost exactly the same as during the heavy loads of the winter months.

As to ice plants operated from central station circuits, some figures on the quantity of energy consumed during the year by several refrigerating installations were given by Mr. W. C. Anderson, of the Canton Electric Co., before the Ohio Electric Light Association, in July, 1911. Of the 10 such installations then in operation in Canton, several had been in use for 8 or 9 years. Below is given the consumption, in kilowatt hours, of each of the six of these plants which are so metered as to give results available for comparison.

ICE PLANTS OPERATED FROM CENTRAL STATION CIRCUITS—ENERGY CONSUMPTION OF REFRIGERATOR INSTALLATION.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Refrigerator installation:						
Tons refrigeration	3	3	5	3	5	3
Motor horsepower	7½	10	20	7½	26	16
Energy consumption:						
Kilowatt hours—						
January	146	646	1,950	....	51	516
February	70	733	2,210	....	34	120
March	112	846	2,070	286	102	892
April	322	1,627	2,600	1,528	1,240	2,168
May	247	1,654	2,850	1,622	1,139	1,928
June	403	2,826	3,600	2,050	1,069	1,976
July	343	4,718	6,040	2,062	2,649	1,978
August	540	5,633	5,590	2,060	2,518	2,212
September	591	4,174	4,790	1,712	2,100	2,200
October	576	2,145	4,200	1,476	1,639	2,052
November	453	1,161	2,630	804	944	1,540
December	335	229	3,310	....	936	264

At the meeting of the Illinois Electrical Association, October, 1912, Mr. J. G. Learned reported that the

Commonwealth Edison Co. then had 2,000-kilowatt capacity connected in ice making. Local ice manufacturers could make ice electrically at a lower cost per ton than the cost of natural ice brought from the near-by Wisconsin lakes. One Chicago ice factory had an electrical load factor of 85 to 90 per cent and turned out its product at 48 to 52 cents per ton, in competition with lake ice costing 55 to 60 cents per ton. Mr. Learned urged central stations to encourage raw-water ice making. The Lincoln Ice Co., Chicago, had an installation of about 450 horsepower in alternating-current motors used to drive compressors, pumps, hoists, etc. This plant had a capacity for producing 120 tons of ice every 24 hours, and was operated throughout by electrical energy. Filtered water from Lake Michigan was used to make the ice. An 80-ton plant at South State and Forty-third Streets had an electric-motor equipment with a rating of about 350 horsepower. Both plants operated 24 hours a day in the summer. They bought electrical energy from the electric-service company on the "off-peak schedule," by which a reduced rate was offered in consideration of the fact that the consumer agreed not to take electricity between the hours of 4 p. m. and 8 p. m. during the months of November, December, and January. By reason of the continuous demand and concessions made in the off-peak schedule, the ice makers were able to obtain a very low rate for electrical energy, namely, about 1 cent a kilowatt hour.

Creamery work.—The O'Neill (Nebr.) Light & Power Co. carries on the unique combination of an electric-light plant and a creamery business. The combination of these two industries made it possible to install an electric-light plant where otherwise the enterprise would probably be of an unprofitable character. The motive power is a 45-horsepower Corliss engine belted to a line shaft. From this line shaft is driven a 50-kilowatt, 3-phase, 2,300-volt alternator at 900 revolutions per minute. For the creamery business there is belted to the line shaft a 10-ton refrigerating machine. The other machinery for the butter and ice-cream making is also driven by the line shaft. The establishment has a capacity of one car of butter per week and 300 gallons of ice cream per day.

CENTRAL STATION STEAM AND HOT-WATER HEATING AND SUPPLY OF STEAM FOR POWER.

Steam heating.—There are a great many central station systems that combine steam heating with their electrical operations, and this would appear to be a growing branch of the industry. Other kindred conditions have developed and have been worked out. The laundry comes midway between the power and the heating load of a station, especially where there is the opportunity to use exhaust steam, a field of work into which central station companies are throwing themselves with energy and success. For instance, in a Minnesota city of 4,500 inhabitants, where the central station has 175 kilowatts in generating equipment driven by Corliss engines, and does a steam-heating business during the winter, summer use for its exhaust steam is provided by heating water for a steam laundry, three hotels, three barber shops, and two apartment buildings. As the plant is operated with a back pressure of from 2 to 3.5 pounds per square inch, winter and summer, this water-heating business is found of great service in helping to carry the plant over the light-load summer period. The steam laundry is the best user of exhaust steam during the summer period. It is located adjacent to the electric plant and is supplied with exhaust steam for water heating through a 3-inch lagged pipe line, and with live steam for its large mangle through a 1-inch high-pressure steam line. The large mangle, two washing machines, and a centrifugal drier are all driven by electric motors, and electric heat is used for the flat-irons and collar machine. The electricity consumed for heating purposes and for motors has averaged about 615 kilowatt hours per month. Steam is sold by meter at an average rate of 70 cents per 1,000 pounds of condensation. The income for the steam used by the drier, mangle, water heater, and several small machines has averaged $22.75 per month. The heating of water for barber shops, flat buildings, and hotels near the plant was also found to be a profitable adjunct of the regular summer service.

The relation of the central station industry to the field of steam heating and hot-water heating is not yet very well defined, but there is already a good deal of relationship and interaction, because obviously the supply of such heat is often necessary within the area covered by the electrical circuits, and a building which requires light and power has also corresponding necessities for heat or hot water in the winter months, or even all through the year. Hot-water supply by central stations so far is a negligible quantity, but there is already a large amount of steam heating. In the report of the committee on steam heating, of the National Electric Light Association, presented at the Seattle, Wash., meeting in 1912, Mr. A. D. Spencer recited the experience of the Central Heating Co. of Detroit, Mich., which operated two stations for heating, one using live steam exclusively and the other depending to a considerable extent upon the exhaust steam from the engines of an electric light and power station. The total number of heating companies in the United States in 1912 was about 250. The National Electric Light Association is particularly interested in those systems, operated in connection with electric supply systems, which either utilize exhaust steam from the generating plants or maintain separate live-steam plants.

These plants are operated either for direct profit by the utilization of exhaust steam (which may be considered a by-product), or on account of the electrical business which can be secured only when heat also is furnished.

Many heating companies, Mr. Spencer said, are not directly profitable. In many cases where profits are claimed it can be shown that no proper separation of costs has been made. Even where costs are separated such items as depreciation are seldom included. Overhead expenses, such as clerical labor, superintendence, plant charges, etc., are often charged entirely to the electrical division. Many companies which at first used exhaust steam only, have become practically live-steam companies, owing to the growth of their heating business. As heating loads and electrical loads have entirely different characteristics and do not coordinate well, it is necessary to restrict the heating service to a point where only a small part of the total exhaust steam available is used, if the use of live steam is to be avoided. As the heating company generally finds it difficult to refuse new business, if it intends fully to occupy the field, growth is inevitable.

Rates.—Heating business can be secured at rates equivalent to the cost to the consumer operating his own plant. Possibly slightly higher rates can be charged, because of the convenience of the service. Residences and small business places, which pay higher prices for coal, should be charged more than larger buildings where engineers are employed and where the coal cost is about equal to that paid by the heating company. As those private plants have no distribution investment and no distribution heat losses, it is hard for the heating company to compete at a profitable rate. In residence districts profitable rates undoubtedly could be charged.

Steam costs, like electric costs, can be divided into service (per customer) costs, capacity (per square foot radiation) costs, and output (per thousand pounds steam) costs. As heating load factors are substantially the same for all customers, it is fair to ignore the capacity costs and to consider costs as made up of service costs and output costs. Rates should be made up of a service charge and a charge for steam used; or at least the system of rates should be such as automatically to cover both elements of cost. This is generally taken care of by a sliding scale of rates which reduces the cost per thousand pounds of steam as the consumption increases. The rates cover all costs, including a proper proportion of overhead charges, interest charges, and depreciation. The last item is very important, as steam-distribution systems are found to be subject to rather rapid deterioration.

Hot-water heating systems use flat rates, as it is impossible to meter the service. Some steam heating systems use flat rates, but the tendency is toward meter rates, which are desirable, as they charge each customer for actual heat used, and do not penalize one customer for the waste of another. They also tend to cause economy in the use of heat, thus permitting the company to serve its customers at lower rates. Flat rates are usually based on the radiation area connected. Under this system it is necessary for the heating company to supervise all installations and specify the amount of radiation required.

Meter rates are based on the pounds of steam condensed. Under this system, supervision of installation is desirable only as a matter of policy to insure satisfied customers. The meter system introduces an element of cost and annoyance in the maintenance of the condensation meters, which are subject to severe operating conditions and are a source of much trouble.

A report received by the committee above named from the New York Steam Co. stated that in its experience the average building uses 25 per cent less steam when operating on a meter than when operating on a flat rate. This has to a considerable extent been borne out by the experience of the heating company in Chicago, which has already transferred several of its customers from a flat-rate to a meter basis. One of the largest office buildings in the country, erected in Chicago, with approximately 90,000 square feet of radiating surface, closed a contract with the heating company for steam service on a meter basis.

Steam power.—High-pressure service for power has proved very unsatisfactory in Detroit, mainly by reason of the inability to meter the service properly and the necessity of keeping the mains alive during the summer months. The service already on the system has gradually been disconnected, and new customers have not been encouraged. Where meters are used it is found desirable to maintain a somewhat elaborate system of inspections. The conditions under which the meters operate are severe. Heat, moisture, and dirt are always present. Defective traps may allow steam to get to the meters. No meter has been found which operates satisfactorily under such conditions without frequent attention. Many smaller companies read and inspect the meters daily. In larger systems this becomes impracticable. In Detroit meters are read every five days. Meters found out of order are promptly repaired. All readings are checked, and sudden decreases in consumption are followed up by inspections. A system of monthly inspections of the large meters is being inaugurated in order to remedy troubles before any revenue is lost. Every summer all meters are overhauled and put into first-class condition.

Customer's installation.—The point of greatest weakness in a district heating system is in the customer's installation. Regulating valves stick, causing too low or too high pressure; traps stick, flooding the system or allowing a leakage of steam into the basement; automatic air valves fail to operate, causing the radiators to fill with air; strainers clog, causing flooded installations; valves leak and ruin floors and ceilings. For these reasons it is essential to maintain a patrol service, in order to keep customers satisfied. It is generally found desirable to have small repairs and adjustments made by the patrol man, rather than to ask the customer to hire a steamfitter. Such repairs are charged at cost of material used. It is found that many customers require considerable assistance and education before they are able to regulate systems satisfactorily. On flat-rate systems, elaborate specifications for customers' installations are essential. On meter systems, certain points are covered by specifications for the protection of the heating company and to insure the satisfaction of the customer.

Decentralized plants.—Another class of steam heating, namely, that from decentralized steam plants, is used by central station companies only in a few large cities, where a great amount of radiating surface is located within very small areas. In Boston and Philadelphia some of these small block-heating plants are operated by the local electric light and power companies, while in New York and in Chicago they are operated by independent steam-heating companies, which cooperate with the electric light and power companies.

ELECTRICITY IN AGRICULTURE.

Power, lighting, and heating.—The use of electricity on the farm has been pursued and developed with extraordinary rapidity in recent years. The chief reasons are the extension of power-transmission circuits from central stations in cities, and the establishment of distribution networks in connection with hydroelectric enterprises looking for patronage of every description. The variety of uses to which electricity can be put on the farm is surprising. Not only are there all the usual services and conveniences utilized by the dweller in the city, but there are many others relating specifically to farm work. The report of the Committee on Electricity in Rural Districts of the National Electric Light Association made in June, 1913, enumerated 50 uses for electricity in the farmhouse itself, 30 applications for electric-motor drive to barn and field machinery, and 20 uses in the dairy. Even this does not exhaust the list, which omits all the work connected with irrigation and with many industries carried on in country districts, such as fruit-canning, digging sand and gravel, and the operation of stone quarries and of sawmills, creameries, gristmills, etc.

Concrete examples of this significant development exemplify what is being done all over the country. At the meeting of the Illinois State Electrical Association in 1911, this subject was brought up, and some most interesting statistics were presented. Mr. E. L. Brown, of Elmwood, Ill., described his local system comprising 30 miles of transmission lines connecting 8 small towns and supplying about 50 farms. Mr. R. H. Abbott, of Petersburg, Ill., described his service to farmers along the route of a 16,500-volt, single-phase transmission line, with step-down transformers lowering to 2,400 volts for the primary distribution. All transformers, poles, lines, lightning arresters, etc., were owned by the farmers, each of whom paid a minimum charge of $2 per month.

An interesting example is furnished by the work done on the Bacon farm, near Grand Forks, N. Dak., where the energy is supplied by the Red River Power Co. A gasoline engine was formerly the prime mover, but now a 3-phase motor mounted on a portable truck supplies all the service. In like manner, at the Bellows farm, of 640 acres, 4½ miles from Maryville, Mo., not only is electric light for the house and barns obtained from the local electric-light company, but a 20-horsepower induction motor on skids is moved around the place and can be connected at several points in and about the barns and silos where work is to be done. The 3-phase, 60-cycle, 2,300-volt transmission line, with painted poles and creosoted butts, was built by the company at the expense of Mr. Bellows, costing about $425. There are nine points at which the motor can be put directly at work. At Montrose, Colo., the local company has a special lighting circuit nearly 6 miles long, built by itself, to reach a group of large fruit ranches west of the city. There are no fewer than 38 such customers, with 14 transformers, of 3 to 5 kilowatt capacity each. The line consists of a single-phase circuit of No. 6 copper on glass insulators, with wooden poles and cross arms, the poles being Idaho 30-foot cedar with 6-inch tops, and set in concrete foundations to a depth of 18 inches, the pole bottoms reaching a depth of 5.5 feet. The cost of the line, with arresters, transformers, and meters, was $800 per mile.

As to the line material, Mr. Theodore Bass, of Farmington, Ill., at the Illinois meeting noted above, described a service to a group of three farms supplied with energy from his 16,500-volt transmission line. The farmers hauled and erected the poles, paying $200 for the high-tension step-down transformer and the three distributing transformers. Iron wire is used for secondaries. Mr. W. G. Austin, of Effingham, reported the successful operation of a 7-horsepower motor at the end of a mile of 2,200-volt line of No. 10 iron wire. Another member stated he had constructed 32 miles of 1,000-volt line, using No. 6 hard-drawn copper wire on 30-foot poles, at a cost of from $150 to $200 per mile.

With regard to the work of the Petersburg (Ill.) Electric Light Co., when the news became known of its plans to build a 16,500-volt transmission line to Greenview and Mason City, a number of farmers along the way served notice on the company that if they could have the privilege of taking service at the town rates, the right of way for the proposed line would be furnished free of cost. With this inducement to supply electricity to neighboring farms, Mr. R. H. Abbott, president of the company, made arrangements to install several step-down transformer substations along the line, reducing to 2,400 volts for distribution to the farms. These single-phase, high-tension transformers are mounted in small houses built on 25-foot poles and are protected only by fuses. At the beginning of 1912, two such substations had thus been erected, one feeding a 2-mile, 2,300-volt line supplying four farmers, and one a 2-mile line for two farmers. The 2,300-volt lines are of No. 6 hard-drawn copper wire carried on 6,600-volt porcelain insulators on 25-foot poles set 40 to the mile, and the regular distributing transformers are equipped with both lightning arresters and 2,300-volt fuses. All of the transformers, poles, lines, arresters, etc., are owned by the customers, so that the company is without investment on their account. A minimum bill of $2 per month is charged each customer, the regular Petersburg schedule applying to the energy consumed. The farmers appreciate the service, and several have fitted up their places with electrical equipment, installing pumps, motors, fans, irons, bathroom heaters, and other appliances.

At Liberty, Ind., the Liberty Light & Power Co. in 1912 furnished electric lighting service from its 32 miles of 13,200-volt and 6,600-volt transmission lines to a number of farmers in the vicinity. The farm owners in the neighborhood of Liberty and Richmond are very prosperous, but were using their electric service only for lighting. The company made a minimum "transformer-loss" charge of $1 a month for each customer. During the winter months, however, some of the farm bills averaged $2 to $2.50, the rate for energy being 13 cents per kilowatt hour. Tungsten lamps were used for general illumination in the farmhouses, the commoner carbon lamps being employed in the barns and outbuildings.

Irrigation and pumping.—An important and somewhat distinct branch of this work has been that relating to irrigation and pumping. A good deal of this work has been done in the West, based on windmills, gas engines, etc.; but with the combination of wells, internal-combustion engines, and ditches a failure, the agriculturist took up the previously neglected electrical pumping. The aggressive policy of certain central stations in building the necessary pole lines to reach such loads has resulted in many interesting and very profitable installations of motor-operated pumps. An installation of this kind is that of Mr. M. A. Lunn, near Denver, Colo. In this case 80 acres were supplied with all the water necessary to change dry, arid land to fertile, productive soil. A 35-horsepower, 3-phase, 220-volt motor is belted to a centrifugal pump which is connected to two lines of 12-inch pipe. The pump is capable of delivering 1,100 gallons per minute against a head of 50 feet. The water is pumped in two directions to discharge points 1,320 feet north and 1,320 feet south, respectively, of the pump house; and from the height of 50 feet it is allowed to flow by gravity through ditches over the adjoining fields. The 13,000-volt transmission lines are tapped for this service, the pressure being reduced to 220 volts at the pump house. All the water used is secured through fillings made on seepage and underflow in a stream known as Dry Creek, an earthen breastwork serving to collect the water flowing in the creek and such seepage as the lands situated on higher levels may supply. The results of the installation have been not only satisfactory but highly gratifying to the consumer.

Even more interesting, because more extensive in its sphere of influence, is the work to which attention is drawn by Mr. C. H. Williams, of the Northern Colorado Power Co., whose system relies on energy from coal, with steam turbines, and whose territory extends from Denver, on the south, to Cheyenne, Wyo., on the north, and from the foothills of the Rockies to a line 50 miles eastward on the plains. All through this arid belt, where rainfall is light and surface water rather unreliable, irrigation is a great stimulus to cultivation and crop values, and the company has gone thoroughly into it. One part of its work is to reach the underflow by electric pumping. The generating plant is 13,200 volts, 3 phase, 60 cycles. For the transmission 44,000 volts pressure is used on the main line, with branches at 13,200 volts, 6,600 volts, and 2,300 volts. The system already built reaches 32 towns in the center of the richest agricultural district in northern Colorado. The lines are run on wooden poles, 40 to the mile, with substations and switching stations about 20 miles apart on the main line, so arranged that any substation can be cut out without interrupting the service. All the territory covered has a copious underflow. The wells dug for irrigation are peculiar. They are either circular or rectangular in form, with concrete curbings lowered to reach down to the water-bearing strata. The pump is submerged and the vertical shaft run up to a framing which carries either a motor with vertical shaft directly coupled or a pulley belted to a motor placed in a housing at the side of the well. The lift being but moderate, centrifugal pumps are used, driven by 2,300-volt motors. During the pumping season of 1910 careful tests were made on 57 pumping plants, with approximately the following results: With an irrigation plant arranged to supply a quarter-section of 160 acres, lifting through a 25-foot head, the average investment required is $7.45 per acre. The cost of operation varies from $1.75 to $2.25 per acre-foot; that is, a foot of artificial rainfall per acre can be obtained for this modest sum. Over much of the territory this additional foot is all that is required, although in other places 2 feet may be necessary. Allowing 10 per cent as fixed charge on the pumping investment, the ultimate cost to the farmer for an acre-foot amounts to only about $2.75. This is much lower than the ordinary cost of water rights and their maintenance, with the additional advantage that the water is always available just when it is needed. The gain by this ability to regulate the time of flow to the condition of the crops has led to not a little pumping by farmers who already have water rights. Besides the use of electricity for pumping, a considerable amount of auxiliary farm machinery is operated in the same manner.

In 1912 over 60 miles of secondary distribution lines were built through the rich and productive farming country of the Sacramento and San Joaquin Valleys, near Stockton, Cal., by the Western States Gas & Electric Co. This system had then a connected load of nearly 2,000 horsepower in the irrigation and farm service of some 700 ranchers. The network of secondary lines, built at an outlay of $90,000, covers 80 square miles of the best farming country, and has been laid out with extensions in view which will cover 2,000 square miles. Irrigation forms an important part of farming operations in this region, the addition of water to the land multiplying its productiveness from two to ten times. Irrigation plants operated by central station service are always ready for use, and are started and stopped with no more effort than is required for the throwing of a switch. Such power service is, of course, a great boon to the small farmer. The rates for electric service are as follows: First 1,000 kilowatt hours, 3 cents per kilowatt hour; second 1,000 kilowatt hours, 2.5 cents; third 1,000 kilowatt hours, 2 cents; fourth 1,000 kilowatt hours, 1.5 cents. Great crops of asparagus, celery, potatoes, onions, beans, grapes, and deciduous fruits are made possible. Within three months, in the summer and fall of 1912, 1,500 horsepower, mostly in small motors driving irrigating plants, had been connected to the lines.

At the meeting of the New England section of the National Electric Light Association in October, 1912, many references were made to the application of electricity to the farm in the East. A paper read by Mr. C. H. Miles, of the Boston Edison Co., referred to its famous tent exhibit. This traveling "circus" comprises all kinds of farm apparatus driven by electricity, and is moved from place to place in a large suburban and rural territory. It is estimated that, by irrigation, land in New England can be made to yield from 50 to 100 per cent more in crops than by depending solely upon natural water supplies. Growers of market-garden products in Arlington, less than 10 miles from Boston, are using land worth $1,000 per acre. The Edison Co. replaced a steam-pumping installation in that town with a 25-horsepower motor driving a centrifugal pump at 3,600 revolutions per minute and pumping about 200 gallons of water per minute against 90-pound pressure. The cost of this energy is but little more than was formerly paid for attendance on the steam pump, and about 30 per cent more water is delivered at a moment's notice. The water in this installation is used through open hose and a series of small nozzles placed horizontally in a supply pipe fixed about 2 feet above the ground, the application of the water thus resembling natural rainfall. During the very dry period in June and July of 1912, the plant was in constant operation and the cost of energy was only about $4 per month per acre.

Miscellaneous uses.—Mr. H. D. Larrabee, Montpelier, Vt., emphasized the advantageous conditions of his territory in the application of electric energy to farming. In the Montpelier district, in one case, a 2,300-volt line was extended 3.5 miles, 40 rural customers being supplied with energy, chiefly for lighting. Thirty-one electric flatirons were sold in two months. In other instances, where motors of from 1-horsepower to 3-horsepower rating were installed for farm service, a 2.5-kilowatt pole-type transformer and a 20-ampere meter were installed at each place. Mr. Eugene Farmer, of Oak Bluffs, Mass., described an educational campaign conducted by the Vineyard Lighting Co. to induce more of the people in its territory to take up agricultural and fruit-raising pursuits. Courses in farming had been added to the high-school curriculum at Martha's Vineyard. At one representative plant a motor-driven pump was operated between midnight and dawn on one section of the farm after another in rotation, thus giving an artificial shower on each section every fifth night. Such service enabled liquid insecticides and fertilizers to be sprayed as and when required. Mr. Taylor, of Poughkeepsie, N. Y., cited the extension of a central station 2,500-volt circuit 1.5 miles to serve 35 farmers, which resulted in the shutting down of six old windmills, the installation, besides lamps, of electric washing machines, fireless cookers, and flatirons, as well as an electric incubator, and the operation of the usual electrically driven farm apparatus. On one model farm with 50 cows a 2-horsepower motor had been installed with a milking outfit. A 9-cent kilowatt-hour power rate was in force.

Egg incubation.—This section should properly include egg incubation, as an increasing number of poultry farms are being electrified. The size of some of the electrical incubators is astonishing. Muskogee, Okla., has one of 30,000-egg capacity, said to be the largest incubator in the world. The growth of the chicks is artificially forced by electric light. Use of motor-driven blowers to circulate the air heated by natural-gas burners has made possible the compact construction of this hatchery, the egg trays of which are superimposed on racks, 20 deep. Five thousand eggs can thus be handled and hatched in a space 2 feet by 4 feet by 4 feet, requiring only about one-tenth of the area and air volume demanded by the old-style incubators. After hatching has begun, trays with high sides are substituted for the incubating trays, each high-side tray occupying the same space as two of the ordinary trays. Although the idea of converting the whole building into a hatchery with superimposed open trays for the eggs is not new, the use of a motor-driven blower at Muskogee to force the evenly heated air to all parts of the tray racks has, for the first time, made this method practicable on a large scale. Humidity of the air is regulated by passing it over open pans of water. A simple thermostat controls the natural-gas supply to the burners through a mercurial valve, keeping the temperature in the incubator constant at 100 degrees. It is stated that chickens thus raised live three electric-light days during two ordinary days of sunshine, so that the 4-week-old electric chicken will far outweigh the sunshine chicken, whose hours of feeding capacity gave it only a 67 per cent load factor, for in the runways the scheme substitutes eight-hour periods of light and darkness. Under the old system of brooding the chicken was idle 8 hours out of the 24, as it could eat all the food it wanted in 8 hours and digest it in another 8. Thus it is evident 8 hours between one dawn and the next were wasted by the improvident chicken, reckless of its short life. No information has been forthcoming as to the effect on the flavor of the chicken working at a 100 per cent load factor, but any inequality can doubtless be rectified by broiling it electrically. The local company finds a steady load in the incubator supply.

Details of an electric incubator at New Orleans, which was put into service with an initial capacity of 6,000 eggs, were made public during 1912–13. It is 40 feet long and 5 feet wide, with 40 compartments, each with a capacity of 150 eggs. The cost of operation is put at 50 cents per compartment per hatch, with various incidental advantages over the former methods.

ELECTRIC VEHICLES.

The more extensive use of the electric automobile has provided a new source of income for the central station, and the service is apparently only at its beginning. According to President W. H. Blood, of the Electric Vehicle Association of America, in 1911-12 there was invested in this country not less than $10,000,000 in electric trucks and $30,000,000 in electric pleasure vehicles; and a production of at least 15,000 electrics of all types was estimated for 1913. A very large proportion of these machines were supplied with charging current from central station circuits. It is only natural, therefore, that throughout the country an effort has been made to develop this new class of business and build up the vehicle "load." The opportunity thus offered is enormous. At the meeting of the Illinois Electrical Association in 1912 it was stated by Mr. George Jones that if half the horses in use in Chicago were replaced by electric vehicles, the central station load created would amount to 94,000,000 kilowatt hours per annum As such vehicles are usually charged late at night, when the ordinary demand for current is small, no additional investment in central station apparatus would be necessary, and this "off peak" business would improve the general load factor about 13 per cent.

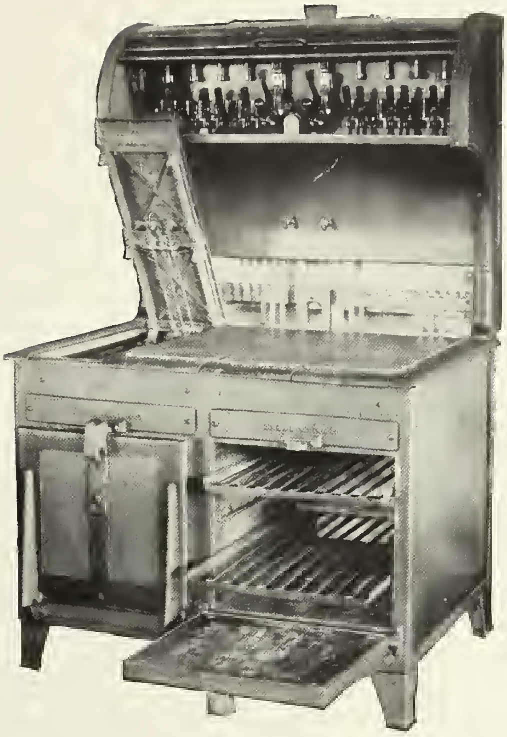
In a paper read before the National Electric Light Association in June, 1913, by Mr. E. E. Witherby, the following remarkable figures were given as to the increase of electric commercial trucks in use in Chicago: November, 1910, 80; November, 1911, 150; April, 1912, 263; November, 1912, 365; January, 1913, 523; May, 1913, 647. One department store in Chicago had in use or on order 139 vehicles, while one brewery in New York had 112 large trucks. At the Brewers' Congress in Boston in October, 1912, one of the speakers stated that electric trucks were saving his company over $80,000 per annum in delivery service. At the end of 1912 the city of Denver had one electric pleasure vehicle for every 217 inhabitants, probably the "record," and due wholly to the energetic campaign for the introduction of electrics made by the Denver Gas & Electric Co. In Boston and all the other large cities the central station companies not only have put in operation large "fleets" of electrics for their own use, but have undertaken, at heavy advertising expense, the education of the public in the use of these vehicles. Some of the companies have themselves equipped electric garages for the convenience of consumers, but in general the conduct of that part of the business is left to private garages, the central station company merely selling current to such institutions or to individuals. An example of the general practice was given before the Electric Vehicle Association in October, 1912, in a paper on the situation in Denver, Colo., by Dr. M. Ekstromer. The Denver Gas & Electric Co.'s rate to private garages on the off-peak basis is a minimum monthly charge of $5, plus 4 cents per kilowatt hour over and above the minimum, with a 10 per cent discount. "Peak charging" at times when other demands are pressing raises the minimum to $7.50 per month. For public garages the rates are about 3 cents, with discounts based upon quantity. Early in 1910 the company established a department of electric-vehicle and storage-battery engineering, which has since done much to standardize garage practice, educate users in the proper care of equipment, assemble and utilize cost data, and promote cooperation among dealers. The company sells no vehicles directly and maintains impartiality between the competitive makes in its territory. An attractive monthly publication is mailed free to all owners of pleasure and commercial electric cars and also to merchants owning and operating gasoline or horse-drawn vehicles and trucks. In June, 1910, there were 3 commercial and 480 electric pleasure vehicles in the city, but in the fall of 1912 no fewer than 57 commercial electric vehicles were in service or on order and 850 pleasure vehicles of the electric type were in service. The vehicle load then called for 2,160,000 kilowatt hours, yielding a revenue of about $64,800 per year. The estimated increase in the next two years was 300 per cent. One coal company, which, according to the Denver Gas & Electric Co., has had exceptional opportunity for studying its electric delivery service, employs a car which hauled 435 tons of coal in one month, a daily average of 18.3 tons. The largest amount of coal hauled in a single day by the truck amounted to 22.1 tons. It covered 63 miles in one day, and the record number of trips was seven. The truck was in service 229 hours, but it was engaged in hauling only 126 hours, 103 hours being required to load coal and unload it. The total mileage for the machine for the whole month was 1,005 miles. It took 119 trips, averaging 8½ miles each, to accomplish that distance.

Use by United States Government.—The Government itself has made considerable use already of electric vehicles, charged chiefly from central station circuits. Among the Federal establishments in Washington which own and operate such vehicles may be mentioned the Navy and Treasury Departments, the Insular Bureau, and the Government Printing Office. Most notable is the work done in New York City through the last census period and down to the present moment in the local post-office service by some 30 machines. Twelve of these electric trucks have made deliveries from 19 postal substations in New York to addressees of large and heavy packages sent through the parcel post. This service was begun with the inauguration of the parcel post, 7 vehicles having been used during the first months, 15 for a subsequent period, and later, by reason of changes in the system, the 12 mentioned. During the month of December, 1913, in 27 days these machines traveled 7,111 miles and delivered 98,243 parcels. At this rate the parcel-post truck fleet covered an average distance of 263 miles per day, or 22 miles per individual vehicle. These trucks, it should be noted, have, however, capacities of 45 miles per charge. Deliveries were made at the rate of 3,628 parcels per day, or about 303 per day per vehicle. The average distance traveled per package delivered was 0.0724 mile, or 382 feet. At the rental paid by the Government for this delivery service the average cost per parcel was 3.3 cents, not including, however, the salary of the carrier who accompanied the truck on its rounds and made the actual deliveries. In addition to the trucks just mentioned, a number of large electric machines are used for mail haulage between the New York City depots and postal stations. Some of these cars have been in service five or six years, having been used 24 hours per day and every day in the year during much of this period. Such mail service is one of the most exacting to which motor trucks can be applied.

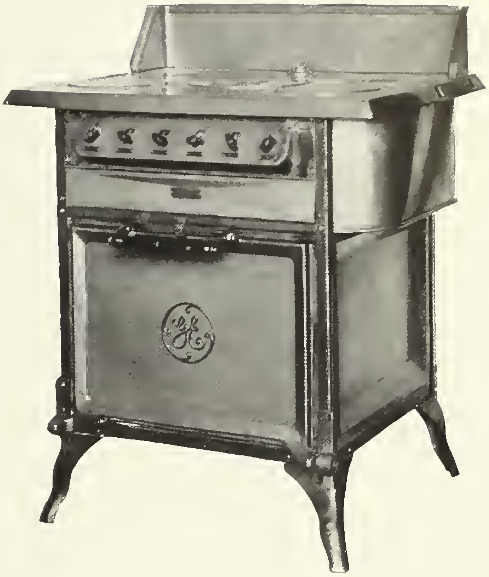
Fire apparatus.—An interesting application of a special character is that to fire apparatus, as exemplified in the equipment of the ladder truck and combination wagon for the Springfield, Mass., fire department, current being supplied by the local United Electric Light Co. The truck carries a total length of 325 feet in ladders and a crew of seven men, and has four 3-horsepower motors and 80 cells of 17-plate battery, the outfit weighing complete 10 tons and making 15 miles at full speed on a single charge. The truck has a guaranteed maximum speed of 20 miles per hour on a level roadway. On a test run it has ascended a 12 per cent grade at a speed of 8 miles per hour. The combination wagon carries a 40-gallon chemical tank, 200 feet of chemical hose, and 1,000 feet of regular fire hose. It is driven by four 3-horsepower motors and weighs 7 tons, having a speed guaranty of 30 miles an hour. Its battery equipment is the same as that of the ladder truck. On a 12 per cent grade it has made a measured speed of 12 miles an hour. Three electrically driven hose wagons were ordered in 1911 by the city authorities. The initial cost of the motor-driven ladder truck was about $12,000. A first-class horse outfit costs about $5,500, but the annual cost of operation by horses is far greater than with electricity. Three horses can not be maintained in the condition necessary for fire department service on less than $1,000 per year. The single item of shoeing horses with the best rubber pads costs at least $4 per month per horse. The small cost of energy at about 3 cents per kilowatt hour is noteworthy, and even if a life of but a single year should be obtained from the battery there would still be a margin of nearly 50 per cent in favor of electricity.

The general relation of the central station industry to the electric vehicle was summed up by Mr. Arthur Williams, then its president, in an address before the Electric Vehicle Association in January, 1913. Ten years ago the price of energy for charging averaged about 23 cents per kilowatt hour throughout the United States, compared with from 3 to 5 cents in 1913. Meanwhile, the price of gasoline has risen and higher prices are probable. Electrical energy tends to fall

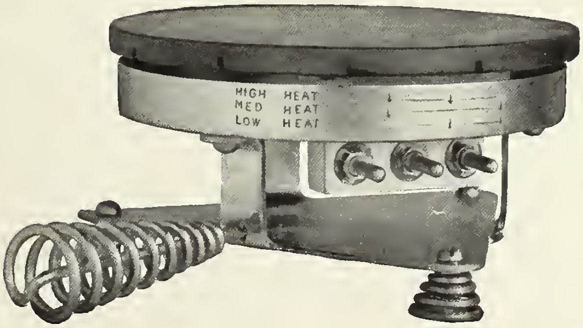
ELECTRIC COOKING.



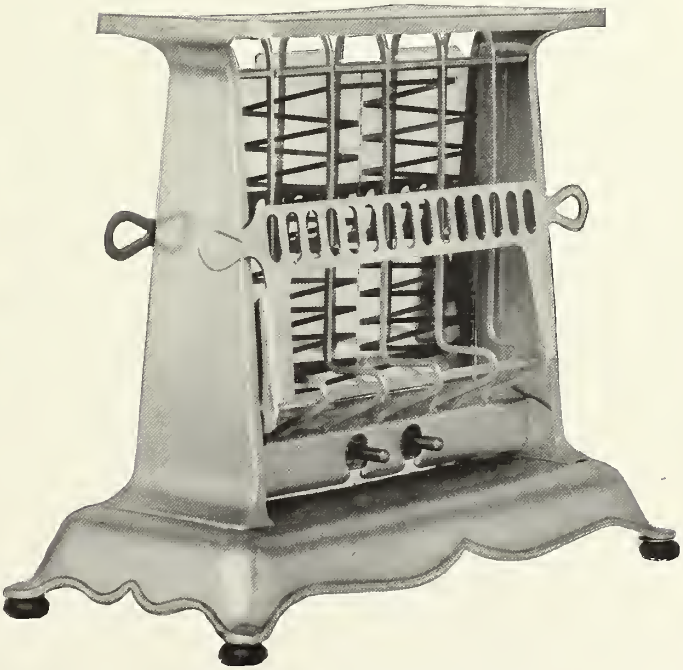
1. HOTEL RANGE.



2. HOUSE RANGE.


HIGH HEAT
MED HEAT
LOW HEAT

3. THREE-HEAT FLAT UNIT STOVE.



4. RADIANT TOASTER, 550 WATTS.

(Face p. 158.)

still lower in price, particularly for "off-peak" loads. Mr. Williams brought out the fact that an investigation of the battery-charging load curve in New York, with special reference to the express business, showed that, with no restrictions on the use of energy, demand was not made for a single kilowatt hour before 7 p. m., in spite of a total consumption at the rate of 1,000,000 kilowatt hours a year. The off-peak character of the load is thoroughly established, so far as the central station as a source of current is concerned.

ELECTRIC HEATING AND COOKING.

Notable advances have been made in the five years in the introduction and perfection of a great variety of apparatus for electric heating and cooking in the home, as well as for a wide range of industries where special and intense concentrated applications of heat are desirable. Some of these have been referred to incidentally in the foregoing text. The best way of exemplifying what has been done in the respective fields is to cite a few typical examples, simply noting as significant of changing conditions that in several small western communities, where there is hardly any other need for a day supply of current, so many electric flatirons are in use that the local central station operates specially on "wash days" to furnish them with current during daylight hours.

In connection with the installation of an electric range in his residence, Mr. Charles H. Williams, general manager of the Northern Colorado Power Co., Denver, in 1911–12 made a thorough study of the cost of electric cooking for a family of six persons for a period of 10 days. Energy was supplied from the commercial circuits of the Denver Gas & Electric Co. The range is suited for 220-volt service and has two 10-ampere and three 20-ampere switches controlling corresponding baking and stove circuits. The table below gives the character of meal, materials cooked, maximum demand in kilowatts, consumption of energy in kilowatt hours, and cost per meal, the data commencing with the installation of the electric range. The cost of electrical energy is placed at 5 cents per kilowatt hour. Records were taken by a pen-recording wattmeter which was carefully calibrated with an instrument of precision. Much care was taken to keep the range absolutely free from dirt during the progress of the cooking tests.

Experience showed that some electrical energy was lost in changing from one heat to another in order to regulate the temperature properly. It was found that after the oven was once heated, baking could be done at small cost. Roughly, the cost of electric cooking varied from 3 cents to 10 cents per day per person upon the basis of the above rate per kilowatt hour.

COST OF ELECTRIC COOKING, FAMILY OF SIX, AT 5 CENTS PER KILOWATT HOUR.

MEAL.	Materials cooked or heated by electric range.	Maximum demand in kilowatts.	Kilowatt hours required.	Cost (cents).
Dinner	4.5-pound roast lamb; baked white and sweet potatoes; baked rice pudding.	2.40	2.70	13.50
Breakfast	Oatmeal; 8 baked apples; coffee	2.24	2.50	12.50
Lunch	Stewed prunes; tea; potatoes for yeast	0.60	0.87	4.30
Dinner	(Clock mechanism disconnected)			
Breakfast	Oatmeal; coffee; kettle of water	2.46	1.40	7.00
Lunch	Warming potatoes; finnan haddie warmed; tea.	2.20	0.65	3.25
Dinner	3.5-pound veal roast; baked sweet potatoes; 10 baked apples; baked Irish potatoes.	2.80	4.35	21.75
Evening	Cooking oatmeal	1.00	0.47	2.35
Breakfast	Warming oatmeal; coffee	0.68	0.55	2.75
	Testing oven, raising temperature from cold to hot.	1.40	0.70	3.50
Dinner	Stewing 4.5-pound chicken; boiled potatoes; toast.	2.08	2.00	10.00
Breakfast	Baked apples, 8; oatmeal; coffee; baking bread; stewing prunes.	2.60	3.20	16.00
Lunch	Boiled potatoes; coffee; 3-pound pot roast		3.15	15.75
	Warming coffee for laundress, 2 p. m.	0.05	0.10	0.50
Dinner	Boiled sweet potatoes; baked potatoes; baked corn bread.	2.40	2.75	13.75
Breakfast	Coffee; oatmeal	1.00	0.55	2.75
Dinner	Beef stew; carrots; potatoes; prune stew	2.00	2.50	12.50
Breakfast	Baked apples; oatmeal	2.48	2.55	12.70
Lunch	Warming meat and coffee	1.40	0.70	3.50
	Baking three loaves graham bread	1.28	1.35	6.75
Dinner	Chicken stew, 4.5 pounds; cranberries, 1 quart; potatoes, boiled (6 large).	1.00	2.15	10.75
Breakfast	Baked apples; oatmeal; coffee	2.50	3.25	16.25
Lunch	Warming meat; coffee	1.60	0.35	1.75
Dinner	Meat pie; potatoes boiled	2.20	2.50	12.50
Breakfast	Oatmeal; coffee	0.60	0.60	3.00
Lunch	Warming meat; coffee; potatoes for yeast	0.90	0.60	3.00
Dinner	Baked finnan haddie; boiled potatoes; baked apple; cream sauce.	2.60	3.50	17.50
Breakfast	Baked apple; oatmeal; coffee	1.00	0.50	2.50

Unsuspected economies are found in the use of electric cooking and heating, as for example in the lessened shrinkage of joints of meat, as compared with those cooked in gas or coal ranges. The saving on a pound of meat thus cooked with all its juices will pay for enough, or more than enough current to leave the consumer on the right side of the balance sheet. A cheaper grade of coffee can be so prepared in an electric percolator as to be superior to more expensive coffees prepared in the usual way. Mrs. W. E. Sweezey, wife of the manager of the Junction City (Kans.) Electric Light Co., in a paper read before the Kansas State Electrical Convention, September, 1911, in telling of her own experience with electric cooking, stated that she had found 30-cent percolator coffee all that could be desired and had given up the use of the 40-cent grade, thus saving $3.90 a year in her coffee bills. Mrs. Sweezey determined to make a test of the energy consumed by her electric cooking range. On the day in question, after a breakfast of bacon and eggs, toast, and coffee, a dinner of fried chicken with gravy, hot biscuits, baked sweet potatoes, mashed potatoes, peach pie, and coffee, and a warmed-over supper, the total consumption shown by the meter was only 3 kilowatt hours.

Several institutions now do their cooking entirely by electricity, among which may be mentioned the Engineers Club at St. Louis and the jail at White Plains, N. Y. The Engineers Club in New York City has had a large electric grill in use for over 10 years.

Commercial bakeries.—It has been several years since samples of flour in the large flour mills were tested electrically, but out of those tests has grown the development of the electric bread bakery, as well as the electric baking of crackers and biscuits, some factories using this method exclusively. One bakery at Milwaukee, Wis., may be noted. It began with a 10-kilowatt outfit, but in 1912 had installed a 30-kilowatt, 360-loaf oven, because experience showed that, compared with the ordinary coal-heated apparatus, the electric oven had the advantages of saving coal and ash storage space, the expense, labor, dirt, and annoyance due to handling coal and ashes, unpleasant heat in the workrooms, etc. The electric ovens, which are built on the multistory plan, occupy only one-fifth the space of the old ovens, and can be started up much more quickly, attaining a baking temperature within 45 minutes after the heat is applied. The new 360-loaf oven has a maximum demand of 30 kilowatts and a running demand of 20 kilowatts. It is in use 20 hours a day, assuring a consumption of about 20,000 kilowatt hours per month. Under these conditions the bakeshop enjoys a rate for current of 2¾ cents to 3 cents per kilowatt hour, the energy cost for baking amounting to about ⅛ cent per loaf. Wheat bread requires 30 minutes to bake, so that the large oven will produce 720 loaves per hour, or 14,400 per day. Rye bread requires a higher temperature, the "medium" heat, for "maintaining," and the "high" heat during 45 minutes for baking. It was proposed at the date given to install an additional and much larger apparatus, giving a total capacity of more than 15,000 electrically baked loaves per day. Electricity is used generally for other operations throughout the bakery, motor-driven dough mixers, cake mixers, and the like, being employed for preparing the flour, etc. The current has even been applied to the inclosed chafing-dish heating units and to the frying pots in which the lard and cottonseed oil are kept boiling for dipping doughnuts. It is the common practice to heat these pots over open flames, and if the hot oil boils over bad fires may result. The application of electric heat removes this danger and helps to lower the insurance rates, which discriminate in favor of electric heating.

MISCELLANEOUS USES AND SERVICES.

Electro chemistry and metallurgy.—It would be difficult to name a trade or industry carried on in the United States in which electricity from central station circuits is not now employed in one form or another. Some of the larger group uses have been indicated or described in the foregoing text. The number could be added to indefinitely, with illustrations from many unsuspected quarters. It is known, for example, that the fields of electro chemistry and metallurgy have broadened extensively in the last few years, but not all the instances of work of this character have yet come to light. Quite incidentally, for example, at the Denver convention of the American Electro Chemical Society, in September, 1913, Prof. J. W. Richards stated, apropos of making steel castings for the mining industry, by means of the electric furnace:

> I will cite a little plant 12 miles from Bethlehem, Pa., that is operating on a local power supply, using the power between 12 o'clock at night and 4 in the afternoon, paying 1 cent per kilowatt hour, melting cold charges of all sorts of scrap iron and steel and making steel castings for the trade in competition with open-hearth castings.

It was stated at the same meeting that the Detroit Edison Co. had established a rate of about $50 per kilowatt per year for electric furnaces; and that in the manufacture of ferro-alloys electrically several hydroelectric plants had energy for sale at a rate of 3 cents per kilowatt hour, or $27 per kilowatt year, on the basis of nine months' guaranteed delivery, and delivery of one-third or one-fourth the full amount during the three months of low water. In 1911 one central station company reported that it was supplying 22 electric furnaces with an aggregate demand of 7,500 kilowatts. The possibilities in this direction are being closely studied, and that progress has been generally made, or perhaps a revolution begun, in the steel industry, involving in future the consumption of vast quantities of electrical energy, may be inferred from the fact that in 1912–13 no fewer than 100 electric steel-making furnaces were in operation. The total rating was 350 tons, requiring an energy consumption of 50,000 kilowatts. The largest single rating of American "arc" furnaces for this work was 15 tons. Corresponding work has been done in many other branches of metallurgy and chemistry.

Curing meats, etc.—One of the miscellaneous uses of electrical current is in the more speedy curing, aging, or ripening of various materials, both liquid and solid, ranging from whisky to hides. The newest of these processes is the curing of meats. A Cincinnati packer discovered that if 60-cycle alternating current be passed through the brine containing hams, the pores of the meat are opened to the fluid and the hams can be completely cured in from 30 to 35 days. This effects a considerable saving in plant space, material, labor, and investment, and the product obtained equals in all respects the naturally pickled ham. The green hams to be cured are piled on trays in wooden vats, 16 feet by 4 feet by 5 feet, each vat holding about 5,000 pounds of meat. At the ends of the vats are the electrodes, each set comprising five 3½-inch carbon cylinders 4 feet long, inclosed in unglazed 6-inch tubular tiles. After the hams are in position the brine, held at a temperature of 34 degrees to 36 degrees Fahrenheit, is turned into the vat and kept circulating by motor-driven pumps on the floor below. From the switchboard a current strength of 30 amperes to 35 amperes, 60-cycle alternating, is turned through the vat, the drop in potential between the opposite sets of electrodes being about 40 volts. This discharge is usually continued throughout the pickling period of a month or more, although experiments seem to show that equally good results are obtained by using the current flow alternately 24 hours on and 24 hours off. In the same way bacon, which ordinarily requires 18 to 20 days, can be completely cured in 3 or 4 days. The plant has had 10 of these 5,000-pound electric vats in continuous service. The curing vats had been in use nearly a year in 1912, and are the result of nearly four years' experimenting. During the course of these tests, direct current was first used, but the products of electrolysis liberated at the electrodes fouled the solution and caused changes in its composition. With alternating current these effects are avoided, but the pore-opening action remains.

Use by physicians and dentists.—A very large field of central station service has been found among physicians, especially those in the electrotherapeutic group, with numerous appliances needing current. Mention must also be made of the requirements of dentistry. In the larger cities the number of physicians and dentists on the circuits can be counted by hundreds. Their work is supplemented by a great deal done in hospitals, and by the purification of water and milk and the sterilization of sewage and other material containing bacteria. Great advances have been made in recent years in the production on the spot of ozone by small machines operated electrically from central station circuits, and these may be found in schoolrooms, banks, theaters, meeting halls, and similar places.

Other special uses.—The use of lifting magnets may also be noted as an invasion of fields of work left previously to mere mechanical apparatus or to manual labor. One of the most notable instances in recent years was the use of such magnets for lifting 15,000 tons of nails, hoops, etc., from a sunken barge in the Mississippi River at New Orleans. The current to energize the "lifters" was supplied from the circuits of the local central station company.

A large proportion of the telegraph and telephone offices now derive from central station systems the prime electrical energy required for the operations of their apparatus and lines, the current being transformed in various ways to suit the conditions of service.

Electric heating finds its way in an unexpected manner into the printing office, and many instances could be noted. Thus, for drying "rush" work rapidly so that it can be delivered or made ready at once for printing on the other side without offsetting, the Bradley & Gilbert Co., printers, of Louisville, Ky., make use of a drying cabinet containing a 770-watt electric heater. This heater sits in the lower compartment of the 5-foot by 3-foot case, and above it, on a light tray of wood slats, the sheets to be dried are placed. Sheets which would require lying undisturbed 24 hours at ordinary room temperatures are thoroughly dried in the cabinet in 30 to 60 minutes and are then ready for handling of any kind. Twenty-five or fewer sheets may be laid on top of each other without offsetting in the drying cabinet, and, of course, this drying space could be increased without additional expense by multiplying the number of trays. So much printing work is required in a hurry, that such an electric drying cabinet is a valuable addition to any printing establishment.

Electric toasters are ordinarily an equipment of the breakfast table, but have been applied by the Brooklyn Edison Co., N. Y., to the curling of feathers for local milliners.

One of the applications of electric heat on the Pacific coast has been the drying of fruit; another, the speedy ripening of walnuts. Seven to ten days are required to ripen walnuts in the open air and sunshine after picking. With electric heat, the time has been reduced to 24 hours.

Electric heat from central station circuits has been applied in crematories at Oakland and Pasadena, Cal. The body is placed in an individual retort. The temperature rises inside of an hour to 2,000 degrees, the organic products undergoing distillation. In another hour nothing remains but mineral matter and ash on a clean tray. There is an entire absence of noise, dirt, or flame, and it is stated that at a charge of $50 per cremation, a substantial profit is shown in this unique service.

After the fire which destroyed the huge Equitable Building in New York City, thousands of bonds, stock certificates, and other securities were dried by electric heat. Many of the banks in New York and other cities have installed electric wax melters.

REGULATION AND RATES.

The recognition and extension of the principle of the control of public utilities by public-service commissions constitute one of the most striking features of American political development in recent years, state after state having fallen into line since the initiative was taken in Massachusetts, Wisconsin, and New York. In most of the states, therefore, the central station industry is now carried on under the supervision of such an authority clothed usually with large powers over the issuance of securities, the standards of service, the disposal of complaints, the regulation of rates, and the control of competition. There has already grown up a vast mass of rulings, decisions, and general literature, constituting in itself a library of liberal proportions, all bearing upon these problems. The difficulties involved in shaping an industry to the requirements of 30 or 40 different commissions can be easily conceived. Some of the public utilities affected find it necessary to issue for the information of operating companies abstracts of rulings and decisions that concern them.

The Wisconsin Railroad Commission.—At the meeting of the Wisconsin Electrical Association in January, 1911, Mr. Edwin S. Mack made a useful summary of the principles the Wisconsin Railroad Commission had recognized or established. The commission had then been in service more than five years, during three years of which it had had jurisdiction over electric light companies. Its decisions and opinions then occupied five printed volumes, in addition to its annual reports. Besides work of a routine character, such as the answering of questions and acting as general counsel and mentor to utilities, the duties of the commission are of two kinds: (1) The setting of standards of service, and (2) the adjustment of disputed cases and service and rate complaints. Good service to the public is exacted by the commission, and if, upon investigation of a case, it finds an increase of rates necessary to enable good service to be rendered, it is disposed to order such an increase. The adjustment of rate cases involves study of many factors. From the gross earnings the operating expenses, including the taxes, must be subtracted, while the rate of depreciation due to age and wear, the reasonableness of return, the correct capital on which to base return, and the percentages allowable for interest and profit must all be determined. In addition to this, costs must be properly proportioned among the various classes of service so that each of these classes shall pay its share. The figures for the gross earnings and operating expenses are usually obtained from the company's books, verified by examination and study of the property in operation.

In considering the amount to be taken as the basis of return it is pointed out that different principles apply from those applicable to property with an open market value. The principal may be taken as the funded debt or bond issue, plus the capital stock and investments. If necessary to appraise the tangible property, the apprisal may be based upon (1) original cost, including additions, or (2) cost of reproduction new, or (3) present value—that is, reproduction value less depreciation. Added into this, of course, are the "service" value, engineering, etc., necessary to make of the integral parts an efficient mechanism.

The "actual total investment" is generally taken as the basis for rate making, when it can be shown that the expenditures have all been prudent compared with the present value of the investment, and that ordinary business sagacity has been employed. When excessive or imprudent investments, not commensurate with the value of service to the customer, have been made, a corresponding reduction is ordered in the basic amount. All values, whether gifts, surplus earnings, or new capital, are considered by the commission as actual parts of the investment. The sale of bonds is recognized as the modern method of raising capital, and bond discounts are viewed as proper items of cost.

"Cost of going value"—that is, the expenditure or deficit involved before the business reaches a profitable condition, with organization perfected, customers connected, and harmonious operation throughout its mechanism—is also regarded as an item of the investment. The cost of going value is computed by a curve chart which traces the elements of the company's business during the first year, given over to construction; the second year, when partial operation began; and the following years, during which the business expanded normally, the income finally exceeding the expenses and netting a profit. Interest at the rate of 6 or 7 per cent is allowed on going value, the higher figure where the service is good, and it can be shown that the plant was not built ahead of public needs or in an excessively expensive or unwise manner, that there are no present prospects of profits, and that the past management has not been incompetent. Obviously, according to the commission's doctrine, public utilities can not retrieve errors or losses as private enterprises can. When a good return has been earned continuously from the beginning of work no cost of going value is considered or allowed by the commission.

When the investment in the property is not ascertainable, or it becomes necessary to check or approximate such investment, recourse is had to the appraisal of the elements of the property by the valuation staff of the commission. This staff was originally formed for the tax commission's service, on the Michigan plan, but now serves that commission and the railroad commission jointly.

Added to the sum of the costs of the elements of the plant as appraised, a general allowance of 10 to 12 per cent is usually made for the expenses of combining them in "harmonious operation." Of the usual 12 per cent allowance, which applies to all but store supplies and paving, 5 per cent is credited to engineering, 4 per cent to interest during construction, and 3 per cent to legal expenses, commissions, and contingencies. The Wisconsin commission usually places this total at 10 to 12 per cent, although many engineers figure 15 to 20 per cent for these expenses. In addition to this percentage, stores and supplies, as part of the working capital, have been allowed up to 1.5 per cent in some cases. The depreciation factors for getting present values are obtained from curve sheets issued by the commission showing various rates of depreciation applicable to elements suffering from different degrees of wear and obsolescence.

The commission has refused to place a capita value on "successful good judgment," as employed in locating a site for a plant, allowing only for the sum actually spent. Allowance has been made, however, for nonoperating property held under reserve or emergency, but not for scrap or superabundant equipment. "Good will" has not been recognized—although the effect of "ill will" has certainly been apparent in cases before the commission. Franchises are treated as having value, but not a value to be respected in rate making. The commission has distinguished carefully the elements of interest and profit, allowing for the first a "reasonable" rate of return, after which the surplus becomes profit. The commission has frequently allowed 8 per cent for electrical concerns, while water companies can get an allowance of but 7 or 6, and municipal plants are limited to 4. There has been a tendency to lose sight of the separate parts of a business in consideration of the whole, although this is contrary to sound cost-distribution methods. The cost of service is generally held to control the rates charged, although this has been modified in the case of small customers, so as not to make it prohibitive. So far as possible, consumers who use current for but a short time daily pay an amount on the fixed costs proportional to their demand, and an amount on the variable costs proportional to their actual use or consumption.

At the Conference of Governors held at Spring Lake, N. J., September, 1911, Gov. McGovern, of Wisconsin, made an interesting address on the routine administration and results of the Wisconsin commission law. The genuinely constructive and enduring character of this method of control is best demonstrated, he held, by the fact that while the people have gained enormously, the utilities have not suffered. On the contrary, they have prospered as never before. Lower rates have not been followed by diminished income, but, by inviting larger patronage, have resulted instead in an actual increase in revenues. To the utilities, therefore, the net outcome has been a gain. As evidence of the prosperity under commission regulation, the last annual report of the Wisconsin commission showed that during the year the operating revenues of electric utilities increased 20 per cent, their net income 29 per cent, and new construction for the year 145 per cent. The operating revenues of water utilities meanwhile increased 7 per cent, their income 13 per cent, and new construction 24 per cent. Gas utilities increased their operating revenues 3 per cent, their net income 15 per cent, and new construction 24 per cent. Telephone utilities increased their operating revenue 11 per cent, their net income 9 per cent, and construction for the year 14 per cent. Railway and traction lines on the average increased their operating revenues 13 per cent, their net income 8 per cent, and construction 8 per cent.

How these results are possible may be illustrated by the case of the Madison Gas & Electric Co. In March, 1910, this company's schedule of rates, based as it was entirely upon the energy consumed, was abolished, and there was substituted a new schedule which took into consideration the elements of installation and classes of consumers, as well as the amount of energy used. In actual experience the form of rate schedule is as important as the rate per unit; and it is the policy of the commission to devise schedules which, while avoiding discrimination and unjust charges, will at the same time encourage extension of the service and thereby decrease the cost per unit. After one year's operation under the new schedule another investigation was made, and it was found that, compared with 1909, the last full year in which the old rates were in effect, the output of the electric plant had increased over 16 per cent, the gross earnings nearly 13 per cent, and the net earnings 24 per cent, while expenses increased less than 3 per cent. Compared with 1907, the number of consumers in the residence class had increased 34 per cent, the number of lamps connected 54 per cent, the kilowatt hours sold 70 per cent, and revenue 35 per cent. Here, however, is the important point: After a year's operation under the commission's schedule, it was found that the business had so increased that it was possible to effect a further reduction of 2 cents per kilowatt hour in the primary rate.

General effect of regulation on public utilities.—The general effect of legislation on public utilities and the effect of commission control are summed up for the census period by Mr. W. J. Hagenah, a well-known authority, as follows:

> The year 1912 will always be of historic importance, not because of the growth of utility control, but because of the more important reason that during this year the substantial results of state supervision which have accrued during the last five years have become generally apparent and the policy of public regulation of utilities recognized as successful. Present conditions give definite promise of the early completion of the third stage of the economic cycle, from which the public utility will emerge greater because of its increased efficiency, more popular because of the diversified ways in which its service has become a public necessity, and more firmly established because of the confidence which it commands and the resulting distribution of its securities among the investors of relatively small means. Less than five years ago the rapid increase of regulatory statutes was regarded with mixed sentiments of fear and approval. The legal power to regulate was recognized, but the ability of a public swayed by misconception and prejudices to lodge such power with men of trained minds and judicial temperament, and to create commissions which would occupy positions of dignity and respect not unlike that of a court, was seriously questioned. It was feared that capable men could not be secured for such services, that the commissions would become subservient to politics, and that capital would grow timid and seek other fields of investment. Events of 1912 have proved these fears to be groundless and have justified the confidence in the public. Unfortunately not all those who possess the power to regulate public utilities are imbued with the judicial spirit which their office demands, and occasionally decisions are rendered which give evidence that considerations of polit-

ical expediency have not been overlooked. Generally such conditions will be found in the first efforts at regulation, or may be accounted for in the same manner that a popular but incompetent individual is sometimes elected to public office, but, on the whole, our utility regulating authorities are composed of men who fairly represent the sentiment of the public, and that sentiment is one which seeks to do justice. The year will therefore be remembered as the period when confidence in public regulation was established, when the justice of regulatory statutes was generally accepted, and when capital frankly sought the profits and the protection which this doctrine affords. No other year in the history of the industry has witnessed such gigantic strides in the development and extension of utility services. The new capital invested in public utilities during 1912 exceeds by far that of any other year. Not only is this true of American capital, but the safety and general attractiveness of the American utility security has appealed to the wealth of Europe, and the present year has witnessed the shipment to this country of funds conservatively estimated to be in excess of $100,000,000 for investment in public utility issues.

When the majority of the public utility laws were drawn up, the fact was recognized that if public service corporations were to be controlled and regulated, they must at the same time be protected. In general, this protection is afforded in two ways—(1) protection from the ruinous effects of aggressive competition where circumstances do not warrant a second utility, and (2) assurance of a reasonable rate of return upon an equitable valuation to reward an adequate service rendered. The first is made possible through the agency of the "convenience and necessity law," which is operative in most states under commission control. The law recognizes that a public service corporation is, in its very nature, monopolistic in character, and protects it from competition except where the public welfare demands the existence of a second utility. The utility commission in administering the law determines whether such a second utility is necessary or not. This provision, as Chairman Roemer, of the Wisconsin commission, has put it, is not intended as auxiliary to the power of the commission to enforce rates and service, as is sometimes erroneously assumed, but is a remedy of last resort and may be applied only in exceptional cases. In Wisconsin not a single certificate of convenience and necessity has ever been granted to a new competitive electric central station, although several requests for such have been made. Under this law it is impossible, practically, for a municipality to operate its own plant in competition with an existing private plant. Under certain conditions the municipality has the right through the law to purchase the private plant at a valuation fixed by the commission. Very few municipalities have availed themselves of this opportunity, for experience has shown that where the public can obtain through its authorities in the commission all the advantages of public ownership, without any of the risks or disadvantages, it is good policy to keep out of a hazardous investment.

In harmony with this general point of view, the public-service commission of Kansas in 1812 handed down a decision protecting a local central station company. Under the law of 1911 no utility can operate until a certificate has been obtained from the commission that public convenience and necessity will be subserved by permitting it to enter the field where another utility of the same kind already exists. The Parsons Railway & Light Co., according to the evidence, was giving satisfactory service from an adequate plant, but an application was made for permission to enter the territory and compete. The commission said that the obvious purpose of the law was to prevent a duplication of utilities under such circumstances, and it denied the certificate.

In like manner the public-service commission of the second district, New York state, issued a decision in the matter of the application of the Red Hook Light & Power Co., defining the legitimate limits of competition and protecting a public utility already occupying a given field. In this case the Red Hook Light & Power Co. applied to the commission, under section 68 of the public-service commission law, for permission to construct an electric plant and a gas plant in the city of Hudson, and to exercise a certain franchise therefor granted by the common council and mayor of that city. The application was denied upon the following grounds:

1. That another electrical and gas corporation was already giving electric and gas service to the city of Hudson.

2. That the service rendered by such other corporation had not been shown by the applicant to be not satisfactory to the public and of such character that a competing company should be admitted into the city.

3. That the contention of the applicant that the other company did not have a franchise in the city of Hudson was one which would not take into consideration that the existing company was in fact occupying the city, and that if it were not there lawfully the remedy lay with the courts and not with the commission.

The same stand was taken in March, 1913, by the Board of Gas and Electric Light Commissioners of Massachusetts. The selectmen of Barnstable had given permission to the Barnstable Co. to put up lines in the town of Hyannis, but the territory was already covered by the Buzzards Bay Electric Co. as to rights granted and as to actual service. To let in the new company would create competition in a large part of the island of Martha's Vineyard. "It is not merely a question as to which of the two companies shall do the business in the town of Barnstable, but whether to the company already there a second company for the same purpose shall be added, so that there shall be two companies engaged in the same business in the same territory." The commission found that the old company was giving good and adequate service and should not be disturbed. "Under all the conditions, in the opinion of the board, it does not appear that the public necessity and convenience require the admission of the Barnstable Electric Co.;" and the appeal against it by the old efficient company that was thus to be raided was sustained and the order of the selectmen was annulled.

In another decision of the same board a different question came up, involving the ability or right of a municipal plant to sell at lower prices than a private utility. It appeared that the Groton municipal plant's cost of production, according to a calculation for the year ended March 1, 1912, was 16.43 cents per kilowatt hour. This figure included operating expense, interest on the investment at 3⅞ per cent, and depreciation at 5 per cent. In the face of this cost figure the town petitioned for a permit allowing it to sell energy for commercial lighting at 12 cents per kilowatt hour. In addition to pointing out the fact that such a course would be contrary to law, the commission in refusing the petition made the observation that "a supply to private consumers for less than cost compels all other taxpayers, many of whom may be unable to obtain the service for their own use, to pay for the special advantages enjoyed by a few."

An interesting state of affairs in Milwaukee was disposed of by a decision of the Wisconsin commission, which practically threw over the shoulders of the Milwaukee Electric Railway & Light Co. a cloak of protection, by requiring other companies that had been let in under the old theory of competition or had been competitive as "block" systems to adjust their rates to a uniform basis and revise their methods of doing business so as to conform to the requirements and policies of the commission. In doing this, the commission took occasion to point out the many evils of competition in the public-utility business, as well as the bad consequences that result from such an unnecessary duplication of equipment.

Discrimination in rates.—One of the most important cases brought before a public-service commission has been that of the New York Edison Co., in regard to complaints on the ground that it had unduly favored large customers with low rates, at the expense of the small customer, with the obvious result, of course, that isolated plants had been shut down or shut out. The Edison Co. filed with the commission a long reply, which, in several respects, is a noteworthy treatise on the rate question as a whole. The cost of supplying electrical energy is stated to consist largely of three elements, namely, fixed charges, customer or stand-by charge, and operating expenses or running costs, in accordance with the view generally accepted by rate experts. But the calculation of the cost of supplying a given customer is declared to be a hopeless task, although the cost of supplying a particular class may be approximated without great difficulty. Fourteen general principles are laid down as essential in preparing any rate schedule, which go to show that while the cost of service is an important consideration it is not wholly controlling, and commercial expediency must always be consulted. Rule 8 brings this out forcibly:

> It is not sufficient that a system of rates be theoretically sound. It must get and hold the business and be simple enough to be understandable by the consumer.

As to the small consumer, Vice President Lieb of the company stated to the commission that the average 10-cent or retail customer, who never uses in excess of 250 kilowatt hours monthly, and represents nearly 80 per cent of all the commercial customers on the company's books, was being supplied below the average cost for service and at a direct loss to the company. As a result of the rate reductions put into effect by the company on July 1, 1911, there was a total decrease in revenue from all sources in the 12 months ended July 31, 1912, of approximately $1,250,000, of which $850,000, or about 70 per cent, went to the benefit of the small lighting customer. Investigation by the company showed that there was no appreciable stimulation in new business as a result of the new rates, which confirmed its past experience as to the futility of relying upon any considerable increase in new business and revenue over the usual natural growth to offset the direct loss of revenue attendant upon the introduction of lower rates. Under the new schedule the average return had been reduced from 7.39 cents per kilowatt hour to 6.87 cents per kilowatt hour, or by approximately 7.03 per cent on all the regular commercial business of the company.

In justification of the general policy of giving a lower rate per kilowatt hour to the motor-service customers than to the retail lighting customers, Mr. Lieb drew attention to the relative costs of supplying these classes of service. In the case of the New York Edison Co., the service connection for the smaller consumer represented an investment of over $65, or more than $542 per kilowatt, while a connection to a larger consumer represented an amount per kilowatt which decreased with increase in the size of the installation until, with an installation of 500 kilowatts or over, the cost of service connections became insignificant and the burden of fixed charges on this feature of the investment was reduced to a minimum. Attention was also called by the company to the fact that the average consumption and income per meter and per customer were continually decreasing for all classes of customers. Average consumption had decreased from 213 kilowatt hours for the year ended July 31, 1908, to 181 kilowatt hours for the year ended July 31, 1912. This decrease was ascribed to several causes, of which the constant extension of the company's service to smaller residences and apartments, by virtue of the lower rates, and the greater extent to which tungsten lamps were used were probably the most important.

The minimum charge.—An important feature in rate systems has been the very common practice of central station companies in making a "minimum charge" per month for their service, or, as it is also sometimes called, a "meter rental." The amount represents a maintenance or "readiness to serve" charge, based upon the idea of requiring each consumer to bear some part of the burden of furnishing the commodity. The practice applies in other utilities than the electric, and prevails in gas and water supply. An average charge is $1 per month minimum, but rates as low as 50 and 75 cents per month are not uncommon, all being returned in service that may be demanded. There are various court decisions and commission rulings on the subject. The railroad commission of California went so far as to authorize the Mount Whitney Power & Electric Co. to put into effect a meter contract or regulation providing for a minimum charge of $24 per year. The Arizona Corporation Commission in September, 1912, ruled in favor of a charge of $1.50 per month, "and in no case shall said charge be made except in case the electricity consumed in any month, charged for at the regular rates, shall be less than the sum of $1.50, and in such case no charge will be made for the electricity consumed."

A ruling of the Massachusetts Board of Gas and Electric Light Commissioners in 1910 as to the minimum charge of the Edison Electric Illuminating Co. of Boston is significant in regard to this matter and may be quoted:

> It is conceded on all sides that a public service corporation is entitled to secure from its customers as a whole a sufficient revenue by which it may live and prosper; and where, as in this case, it has a business well established, the imposition of such a charge is probably of more consequence to the general body of its customers than to the company itself. In other words, the interests of the company and those actual users of electricity who are dependent on the company for their supply are so far identical that it is desirable from the standpoint of both, perhaps more emphatically from that of such consumers, that the company's business shall expand and develop along profitable rather than unprofitable lines, so far at least as may be consistent with a proper regard to the company's duty as a public servant. Electricity is fast becoming one of the common conveniences and even necessities of life, and the board believes that it should be made available to a much larger portion of the community than it now is. But, in view of the constant advancement in the art, and of the large investment incident to placing wires underground in many cities, a too rapid expansion of the company's business in directions where, under present conditions, there is no substantial demand may perhaps hinder, rather than help, that promotion of its use which the board believes is on the whole so desirable. It is largely because of these considerations that the board reached the conclusion that for the present it ought not to require the discontinuance of some minimum charge.
>
> If such a charge is to be permitted, its amount is a matter of expediency respecting which the board is not inclined to interfere, unless the manner of its imposition tends to work a real hardship upon small customers, and so become a palpable evasion of the company's public duty. Respecting the present charge the board is convinced that no increase in amount should be allowed, and that a smaller amount might be desirable.
>
> If the company shall continue to impose a minimum monthly charge upon its customers who pay the prevailing maximum net price, such charge shall not exceed $1 per month per meter; and if on any thirtieth day of June it shall appear that a customer has, by reason of said charge, paid or become liable to pay during the year immediately preceding an amount exceeding the minimum monthly charge multiplied by the number of months in which he has been a customer, and an average price for electricity supplied by meter exceeding the prevailing maximum net price per kilowatt hour, the company shall refund all such excess; provided, however, that nothing in this recommendation shall be construed to require the company to render its service at an average charge per month less than the minimum monthly charge, or at an average price per kilowatt hour less than the prevailing maximum net rate.

The New Jersey Board of Public Utilities, one of the more recent creations in the commission field, placed on record January 16, 1912, the following conclusions as to the minimum charge:

> *First.* That a minimum charge is a reasonable rule or regulation for an electric-lighting company to make.
>
> *Second.* That the making of this charge by the month is just and reasonable, and is really more equitable than if the charge were made by the year.
>
> *Third.* That a charge of $1 per month "per plant for installation" is just and reasonable, but that a charge of $1 per meter is excessive where more than one meter is installed. A minimum charge of 50 cents per month per meter is not excessive or unreasonable for each additional meter installed on the same premises, for the same customer, supplied through the same service.
>
> *Fourth.* That where a customer requests that service be discontinued for a period of at least one month or more, the minimum charge should be waived during such period.
>
> *Fifth.* That where a customer requires the service for a limited period only, a reasonable charge may be made for the work of connecting and disconnecting the service at the beginning and end of the short period.
>
> The minimum charge is part of the rate schedule, and should be incorporated with it whenever it is compiled for examination by the public.

As to electric-motor service the ruling held that a minimum charge of 50 cents per horsepower per month was not excessive or unreasonable. It might work out as an apparent hardship to a few small consumers who used their equipment but a very short time, in some cases not more than four or five hours a month. The fact could not be lost sight of, however, that the supply of electric power was strictly a commercial proposition, that to relieve one customer from the payment of any considerable portion of the cost would merely result in transferring the burden to other customers, and that such a transfer did not appear to be justified. The board, therefore, determined that in connection with the sale of electricity for power purposes the minimum charge of 50 cents per horsepower per month established by a company furnishing such service was not excessive or unreasonable. It was further ruled that the smallest minimum charge made in connection with electric-power service, $1 per month, was not excessive or unreasonable.

In the state of Washington the public service commission in a ruling of November 16, 1912, held that a minimum charge is a reasonable practice which tends to distribute equitably the cost of operating and maintaining the plant among all patrons who, by reason of their service connections, are in a position to make demand upon the company for service. It was set forth that the practice of collecting a minimum charge of this character was sanctioned by custom and authority, and was followed by the city of Seattle with respect to its municipally owned water and lighting systems.

The Wisconsin Railroad Commission has rendered many decisions on this subject, and it would be difficult and, indeed, unnecessary here to compile all of them. But, as usual with that pioneer body, they go to the heart of the problem. In the appeal of the Lancaster Electric Light Co. several points were raised. Application was made by the company for authority to put in effect a minimum rate of $1 per month. An analysis of the operating expenses showed that the consumer costs to the company amounted to 46 cents per meter per month. In addition to this amount, if a customer consumed two kilowatt hours per month, the value of current used at the rate charged, 12½ cents per kilowatt hour, would be 25 cents per month. The minimum bill, therefore, must be high enough to cover these fixed costs and also the average value of current used by the class of customers who, in general, consume the smallest amount of current. Under the circumstances, the proposed minimum of $1 per month would be unnecessarily high, and a minimum monthly bill of 75 cents would be reasonable and just. The company was authorized to put such a rate into effect. The commission said:

> As repeatedly stated by this commission, the minimum bill rests, for its justification, upon certain expenses which are incurred by a utility because of its being in a position to serve. In other words, the minimum bill for an electric lighting utility may be greater than the amount which would be derived from the consumer in question if he were charged merely for the current used at regular rates, and this is due to the fact that the utility incurs certain expenses because of its readiness to furnish current to the consumer, irrespective of whether or not he actually uses current. These expenses are such as arise because of the consumer's premises being connected to the lines of the utility, and may be determined with a considerable degree of accuracy.

In a similar case in 1911 as to the Bloomer electric light plant the commission said:

> The operating expense of an electric plant includes several items which vary with or are proportional to the number of metered consumers. The expense of reading meters, maintaining meters, delivering bills, and carrying the customers' accounts are expenses which bear little or no relation to the current sold. These costs go on month by month, whether the consumers use much or little current. Interest, taxes, and depreciation on the investment represented in the meter are expenses which the plant must bear and which it rightly expects to have returned to it. By adding the direct consumer expenses to the fixed charges on the meter investment and also making a sufficient allowance for the current which will be consumed under the minimum bill, the minimum charge may be definitely determined.

The Ohio law of 1911 says in this respect:

> Nothing in this act shall be taken to prohibit a public utility from providing for a minimum charge for service to be rendered unless such minimum charge is made or prohibited by the terms of the franchise, grant, or ordinance under which such public utility is operated.

Heating and cooking rates.—Special attention has been paid by central stations in recent years, as already noted, to the development of electric heating and cooking, and it has been sought to encourage this class of service by a lower rate. There might be mentioned a number of interesting examples of the results of energetic campaigns by the central stations to annex this business, applying to all kinds of apparatus used in the household. One illustration, however, must suffice. Early in the summer of 1912 there was begun by the commercial departments of the Great Shoshone & Twin Falls Water Power Co. and the Southern Idaho Water Power Co., of Pocatello, Idaho, a campaign of advertising, publicity, and education of the public in the use of electricity for cooking purposes. Newspaper advertising was followed by a rapid succession of circular letters, tending to interest the public further in the advantages of the electric range over fuel-burning stoves. Public demonstrations of electric cooking were held, and the people turned out by the hundreds. At one exhibition in Twin Falls more than 1,000 visited the display rooms in one day, and each was served with a small portion of a daintily prepared, electrically cooked food. The demonstrations were followed up by well-planned solicitations for the sale of electric ranges among consumers.

During the fall of 1912 about 60 complete electric ranges of various sizes were sold. A carload of 125 ranges was ordered later during the winter, and practically all of this shipment was disposed of in advance. Five hotels and several restaurants and bakeries discarded all kitchen fuel and are using electricity exclusively for cooking and baking purposes. One of the incidental obstacles was the difficulty experienced in finding a market for the old fuel ranges.

The two companies adopted a rate of 2.5 cents per kilowatt hour for energy used for domestic cooking. For commercial cooking the guarantee-rate schedule is as follows:

Monthly guarantee per kilowatt connected.	Rate per kilowatt hour (cents).
$1.50	2.0
2.00	1.5
2.50	1.4
3.00	1.2
3.50	1.0

From the records of the company it would appear that the average income from the domestic cooking ranges installed prior to April 1, 1913, was $3.89 per range per month.

Herewith is given a group of rates in various cities where special schedules for electric heating and cooking have been put in force. The rates quoted are those under which service was given in 1912.

Atlanta, Ga.—The ordinary power rate ranged from 6 cents per kilowatt hour to 3 cents per kilowatt hour, but special consideration was given in the matter of estimated demand, which was figured at 50 per cent of the connected load.

Altoona, Pa.—Four and half cents per kilowatt hour on separate meter.

Boston, Mass.—Miscellaneous rates for cooking and heating and other uses; 10 cents per kilowatt hour for the first 20 kilowatt hours per month; 3 cents per kilowatt hour for excess use. Minimum charge, $12 per year. Under certain off-peak conditions and for large consumption the rate for over 2,000 kilowatt hours was reduced to 2 cents per kilowatt hour.

Des Moines, Iowa.—Four and half cents per kilowatt hour on separate meter.

Detroit, Mich.—The maximum power rate, 4 cents per kilowatt hour, was used.

Duluth, Minn.—Rate for cooking and heating, vacuum cleaners, and washing machines, 3 cents per kilowatt hour, less 20 per cent prompt payment discount. Minimum charge, $1 per month.

Kansas City, Mo.—Cooking rate 4½ cents per kilowatt hour. Separate meter used.

Los Angeles, Cal.—Five cents per kilowatt hour, with separate meter. Minimum charge, $3 per month.

Memphis, Tenn.—One dollar and fifty cents per month per kilowatt of demand, plus 3 cents per kilowatt hour.

Omaha, Nebr.—Cooking rate, 6 cents per kilowatt hour; 5 per cent discount if complete cooking outfit was installed. No heating rate.

Portland, Oreg.—Four cents per kilowatt hour. Minimum charge, $1 per month.

Redding, Cal.—Three cents per kilowatt hour for the first 100 kilowatt hours per month; 2½ cents for the next 100 kilowatt hours per month; 2 cents for the next 100 kilowatt hours per month; 1½ cents for excess over 300 kilowatt hours per month. Minimum charge, $1 per month. Approved by the California Railroad Commission.

Salt Lake City, Utah.—Six and six-tenths cents per kilowatt hour with separate meter. Minimum charge, $2 per month. Prompt payment discount, 10 per cent on all charges, including minimum.

Seattle, Wash.—Three cents per kilowatt hour with separate meter. Minimum charge, $2 per month.

Spokane, Wash.—The industrial rate, 5 cents per kilowatt hour.

Springfield, Mass.—Heating rate, 6 cents per kilowatt hour. No cooking rate.

Superior, Wis.—Five cents per kilowatt hour for the first 50 kilowatt hours per month. Four cents per kilowatt hour excess use.

The Mount Whitney Power & Electric Co., Visalia, Cal., operating two water-power plants and two steam plants, with circuits covering the greater part of Tulare County and extending into Kern County, had developed an irrigation pumping load to a point where it became the main part of the company's business, which left a very large winter valley in the yearly load curve. To correct this, after thorough investigation the company in 1912 sought the domestic heating and cooking business, adjusting the prices as experience indicated, and developed a very successful service in that field. It is expected that within the next few years electricity for cooking and heating will be quite as universally used in this locality as it is now for lighting and pumping. The rates were worked out to fit the conditions, as follows: It was deemed reasonable to obtain the lighting rate of 9 cents per kilowatt hour for the current used for lighting, about 3 cents per kilowatt hour for cooking, and 1 cent per kilowatt hour for heating. To reduce the investment in meters and the cost of handling accounts, one meter is used for each residence, and these rates are combined by using a sliding schedule, each section to cover the average consumption of its class of service. The resultant existing rates are:

Combination lighting, cooking, and heating.—Ten and one-half cents per kilowatt hour for first 20 kilowatt hours per month; 3.5 cents per kilowatt hour for next 150 kilowatt hours per month; 1 cent per kilowatt hour for excess over 170 kilowatt hours per month.

Prompt payment discount, 15 per cent on bills paid within 10 days.

Minimum charge, $2 per month.

Heating.—(Lights registered on separate meter) available for residences and business houses and offices, 3.5 cents per kilowatt hour for first 150 kilowatt hours per month; 1 cent per kilowatt hour for excess over 150 kilowatt hours per month.

Prompt payment discount, 15 per cent on bills paid within 10 days.

Minimum charge, $1 per month.

Cooking.—Available for hotels and restaurants, 3.5 cents per kilowatt hour.

Prompt payment discount, 15 per cent on bills paid within 10 days.

Flat rate.—Available to all consumers for water or other heaters operating continuously, $8.30 per kilowatt per month.

Prompt payment discount, 15 per cent on bills paid within 10 days.

Electric vehicle rates.—Intermediate between the schedules just cited and those for very large power consumers are those which apply to electric vehicles, in regard to which a wide range of practice exists, the aim being to build up a demand for current in the "off-peak" hours of the night, when the generating plant would otherwise be called upon for a relatively small amount of current. A garage put in operation in Chicago in 1912 is an example of an effort to make the charge equitable to the customer. The rate there is divided into two portions—a fixed charge of $20 per month for storage, maintenance, and oiling; and a second charge for power at the rate of 4.5 cents per kilowatt hour for the first 300 kilowatt hours and 4 cents after that limit has been passed.

In the report of the committee on rates and charging stations presented at the Chicago convention of the Electric Vehicle Association of America, October, 1913, it was stated that up to that time very little advance had been made by the public garages toward providing a separate scale of rates for the current used, the prevalent practice being a monthly rate depending upon the size of the vehicle, or a flat price per charge, regardless of the quantity taken. Out of 128 answers to the committee's questions, the reports from only 31 cities indicated that the garages in their districts were metering the current.

The committee reported that the average for a total of 91 of the largest cities in the country showed a rate of 3.007 cents per kilowatt hour paid by public garages, and 5.338 cents by private garages.

Some of the central station companies maintain garages or storage-battery service for which special rates are in vogue. Thus the Hartford (Conn.) Electric Light Co. buys, maintains, installs, and charges in the customer's truck all the batteries needed for its continuous operation. For this service the company charges a flat rate of from $15 to $60 per month, depending on the size of the truck, to which is added a mileage charge of from 1½ cents to 7 cents, depending upon the capacity of the truck and the miles traveled per month.

The report above referred to gives the electric vehicle current-supply rates from 128 central stations arranged alphabetically. It will be necessary to quote only a few of these as typical. The wholesale rate is given on the first line; the retail rate on the second.

Akron, Ohio	3c. to 1.5c. per kwh.; minimum $1 per kw. No cash discount. 5c. flat per kwh.; minimum $1 per kw. No cash discount.
Allentown, Pa	8c. to 2.6c per kwh.; minimum 50c. per hp. 10 per cent cash discount. 8c. to 2.6c. per kwh.; minimum 50c. per hp. 10 per cent cash discount.
Atlanta, Ga	5c. to 1.5c. per kwh.; minimum $1.11. 10 per cent cash discount. 5c. to 3c. per kwh.; minimum $1.66. 10 per cent cash discount.
Aurora, Ill	$1 per hp. plus 4c. to 2.5c. per kwh.; minimum $3. $1 per hp. plus 4c. to 2.5c. per kwh.; minimum $3.
Auburn, N. Y	$1 Demand plus 4c. to 1.5c. per kwh.; minimum $1. $1 per hp. plus 4c. per kwh.; minimum $2. 10 per cent discount.
Baltimore, Md	4c. per kwh; minimum $5 for each vehicle. 5c. per kwh.; minimum $5.
Binghamton, N. Y	$2.50 kw. of demand plus 1c. per kwh. First 100 kwh. 5.5c.; excess 3.33c., less 10 per cent; minimum $4.
Bloomington, Ill	3c. net per kwh.; minimum $5. 5c. net per kwh.; minimum $5.
Boston, Mass	10c. to 2c. per kwh.; minimum 75c. per meter. 10c. to 3c. per kwh. with discounts additional; minimum 75c.
Bridgeport, Conn	7c. per 100 kwh., or less to 3.25c. for 4,800 kwh. or over; minimum per hp. $1.50 to 50c. 7c. per 100 kwh., or less to 3.25c. for 4,800 kwh. or over; minimum per hp. $1.50 to 50c.
Brockton, Mass	10c. to 4c. per kwh.; minimum $1. 10 per cent discount. 7c. per kwh.; minimum $1. 10 per cent discount.
Brooklyn, N. Y	10c. to 3c. per kwh.; minimum $1 hp. Quantity discount. 10c. to 3c. per kwh.; minimum $1 hp. Quantity discount. Flat rate 5c. per kwh. No minimum. No discount. Flat rate 5c. per kwh. No minimum. No discount.
Buffalo, N. Y	Primary charge $3.25 to $2.50 per kw.; second charge 1.5 to 1c. per kwh. Discount 25c. kw. 8c. to 1.5c. per kwh.; minimum $1. Discount 1c. per kwh.
Cambridge, Mass	5 5/9c. to 2½c. per kwh.; minimum $1 per hp. Discount 10 per cent 15 days. 5 5/9c. to 2½c. per kwh.; minimum $1 per hp. Discount 10 per cent 15 days.
Canton, Ohio	Maximum 6c.; average 3c. per kwh. Maximum 6c.; average 4c. per kwh.
Chattanooga, Tenn	5c. to 2c. per kwh.; minimum $1.053 per hp. Discount 5 per cent. 5c. to 2c. per kwh.; minimum $1.053 per hp. Discount 5 per cent.
Chicago, Ill	Guaranteed maximum rate 4½c. per kwh.; minimum 50c. per hp. connected. 11c. to 6c. and 4c. per kwh., less 1c. for cash, minimum 50c. per hp. connected.
Chicago (suburbs)	Direct-current, primary 50 kw. at $1.40, excess at 90c.: secondary 5c. to 9c. Discount 10 per cent secondary charge. 11c. to 6c. and 4c. per kwh., less 1c. for cash; minimum $1.50 per charge plug.
Clinton, Iowa	Flat rate 5c. per kwh. Flat rate 5c. per kwh.
Colorado Springs, Colo	Fixed charge 50c. per hp. connected, plus 7c. to .77c per kwh. 10 per cent discount; minimum $1 hp. 11c. per kwh., less 45 per cent discount; minimum $5.
Council Bluffs, Iowa	6c. per kwh., less 10 per cent discount; no minimum. 6c. per kwh., less 10 per cent discount; no minimum.
Dallas, Tex	5c. to 3 1/3c. per kwh., less 10 per cent. Discount 50c. hp. Connected minimum. 5c. to 3 1/3c. per kwh., less 10 per cent. Discount 50c. hp. Connected minimum.
Danville, Ill	5c. to 2c. per kwh. Must be used during off-peak hours. Flat rate 5c. per kwh.; minimum $5.
Dayton, Ohio	4.2c to 3c. per kwh., according to hours use of demand, 5 per cent discount. 6.6c. to 5.4c. per kwh., less 5 per cent; no minimum.
Denver, Colo	$1 hp , plus 4c. kwh., less 10 per cent; also $2 per hp., plus $1.75, less 10 to 15 per cent discount. Flat rate 4c. per kwh., less 10 per cent; minimum from $5 to $12.50.
Des Moines, Iowa	5c. to 3c. per kwh., depending upon hours use of capacity, 5 per cent discount; minimum $2.50. 5c. to 3c. per kwh., depending upon hours use of capacity, 5 per cent discount; minimum $2.50.
Detroit, Mich	Flat rate 3c. kwh., less 5 per cent or demand $3 per kwh. plus 1c. to 6c. per kwh.; minimum $1. Flat rate 4c. per kwh., less 5 per cent discount; minimum $1. Flat rate 2c. per kwh. Do not sell to private garages.
Dover, N. H	Flat rate 4c. per kwh. net. Flat rate 4c. per kwh. net.
Dubuque, Iowa	Flat rate 6c. per kwh., less 1c.; minimum $1 hp. 10c. per kwh. down, according to quantity; minimum $1 per hp.
Duluth, Minn	3c. per kwh., less 20 per cent discount; minimum $15 per month. 6c. per kwh., less 20 per cent discount; minimum $4 per month.
Elmira, N. Y	7c. to 2c. per kwh. 7c. to 2c. per kwh.
Erie, Pa	3c. per kwh., less 5 per cent; minimum 75c. month. 5c. per kwh., less 5 per cent; minimum 75c. month.
Evansville, Ind	Fixed charges $2 net per active kw., plus 1c. per kwh. 5c. to 2½c. per kwh., less 10 per cent; minimum 50c. per hp.
Fall River, Mass	6c. to 1½c. per kwh., less 10 per cent; minimum $1 per hp. 6c. to 1½c. per kwh., less 10 per cent; minimum $1 per hp.
Fort Smith, Ark	5c. to 1.99c. per kwh. 5c. to 1.99c. per kwh.
Fort Worth, Tex	5c. to 3c. per kwh.; minimum $1. 5c. to 3c. per kwh.; minimum $1.

Supply and rates to railways.—As typical of the heavy power contracts and rates made by central station companies may be given in abstract the terms agreed to between the Great Falls (Mont.) Power Co. and the Chicago, Milwaukee & Puget Sound Railway in 1912–13. The plans for the electrification of the railway, from Harlowton, Mont., to Avery, Idaho, a distance of 440 miles, include the supply of wholesale power from the Great Falls Power Co., Great Falls, Mont., with plants at Rainbow Falls and Black Eagle Falls on the Missouri River. The railway company agreed to electrify its line between Harlowton and Deer

Lodge, Mont., a distance of 238 miles, before January 1, 1918, and also to buy from the power company electric energy at the rate of 10,000 kilowatts, maximum demand, for the full period of the 99-year agreement, but two years' notice is to be given the power company as to the time when delivery must begin. The railway company has several options for more power, up to a total rate of 25,000 kilowatts, maximum demand, the agreement as to this additional demand being as follows: Not less than 4,000 kilowatts, nor more than 8,000 kilowatts, if called for prior to January 1, 1923; not less than 3,500 kilowatts, nor more than 7,000 kilowatts, if called for at any time between January 1, 1918, and January 1, 1928, if at least 6,300 kilowatts additional has been called for prior to January 1, 1923. Additional energy, when once called for, as above, will be supplied for the entire remaining term of the contract.

Delivery of energy will be made to not more than five receiving substations between Deer Lodge and Harlowton, at 50,000 volts or 100,000 volts, three-phase, 60 cycles, alternating current. The railway substations are to contain sufficient synchronous machinery to secure a power factor of at least 80 per cent. The power company will have the right to install regulators in the substations, for the operation of synchronous machinery, in such manner as to receive any power factor between 80 per cent leading and 80 per cent lagging. The rate of energy will be 5.36 mills per kilowatt hour, subject to a minimum bill, after the first year of service, equivalent to 60 per cent of all the energy contracted for. The power company is also required to pay the Federal Government a tax of 5 mills per 1,000 kilowatt hours for all energy delivered over transmission lines crossing the public domain.

This region is mountainous, embracing some very heavy grades, and it is estimated that electrical operation will result in large economies as compared with operation by steam locomotives using expensive fuel.

Rate schedules.—Herewith are appended a number of typical rate schedules from various American cities, which have been reduced to uniformity, enabling better comparison, on the basis of the scale or schedule provided by the rate research committee of the National Electric Light Association; but before presenting them it is desirable to exhibit the general conditions as to average rates prevailing in 1912 in 30 representative cities of the United States.

Of the 30 cities, 1 had a population of less than 25,000, 9 had populations between 25,000 and 50,000, 8 between 50,000 and 100,000, 7 between 100,000 and 200,000, 4 between 200,000 and 500,000, and 1 in excess of 1,000,000.

It is perhaps better to summarize the rates of some of the larger cities for 1913–14, instead of attempting to present all the voluminous schedules. Even from this brief synopsis, which follows the tabular statement, the complexity of the tariffs dealt with may be inferred, but, whatever the method employed, the aim of the companies has naturally been to cultivate and develop the universal use of electricity.

AVERAGE RATES FOR CENTRAL STATION SERVICE IN THIRTY CITIES.

INSTALLATION.	Connected load (kilowatts).	Maximum demand (kilowatts).	Monthly consumption (kilowatt hours).	Average rate per kilowatt hour (cents).
Residence, large	3.0	2.2	127	9.1
Residence, small	0.6	0.5	27	9.4
Retail store, large	7.0	7.0	1,126	6.3
Retail store, small	0.5	0.5	67	8.1
Drug store	1.5	1.5	200	7.4
Saloon	1.5	1.5	377	6.4
Church	5.0	5.0	156	8.7
Industrial, 1 motor	1.5	2.0	109	6.6
Industrial, 2 motors	3.7	5.0	286	6.0
Industrial, 3 motors	10.3	10.0	244	6.7
Industrial, 8 motors	18.7	25.0	3,318	3.2
Industrial, 20 motors	59.7	50.0	4,180	3.5

Boston.—Steam only. Meter rate, 10 cents per kilowatt hour. No discount; lamps free. Minimum, $9 per year. State regulation fixed 12-cent rate; present rate reduced by company.

New York.—Steam only. Block rate, 10 cents first 250 kilowatt hours; 9 cents next 250; 8 cents next 250; 7 cents next 250; 6 cents next 500; 5 cents excess over 1,500 kilowatt hours. No discount; lamps free. No minimum charge.

Buffalo.—All Niagara water power. Wright demand, 7 cents first 60 kilowatt hours' use per month; 4 cents next 120 kilowatt hours; 1.5 for excess. Maximum demand, residence one-quarter connected load; commercial one-half connected load. Minimum charge, $12 per year. No lamp renewals; no discount. Rate fixed by state commission. Pending court review, commission has allowed company to charge one-half cent additional on use over 60 hours.

Philadelphia.—All steam. Alternating current, overhead, 10 cents straight line meter rate. Direct current, underground, 12-cent straight line meter rate. Free lamps; no discount up to $10. Minimum charge, $1 per month. State commission has not regulated rates.

Baltimore.—Susquehanna water power, steam auxiliary. Eight and one-half cents per kilowatt hour, meter rate. Minimum charge $12 per year. Free lamps; no discount. Rate fixed by state commission after complete investigation.

Washington.—All steam. Wright demand, 10 cents first 120 kilowatt hours per month; 5 cents excess kilowatt hour; minimum charge $1; lamps free. Delay payment penalty 1 cent per kilowatt hour. District commission has not regulated rates.

Chicago.—All steam. Wright demand, 11 cents first 30 kilowatt hours' use per month; 6 cents next 30 kilowatt hours' use per month, 4 cents excess kilowatt hours. Maximum demand estimated percentage of connected load up to 30 lights; measured by indicators over 30 lights. Lamps free; no minimum charge; prompt payment discount 1 cent per kilowatt hour. Rates fixed by state council 1913 for five years.

Cleveland.—All steam. Wright demand, 10 cents first 36 kilowatt hours use assessed maximum demand, 5 cents next 30 hours, 3 cents excess kilowatt hours. No discount; no minimum, free lamps. State commission can not regulate rates in first instance. City council early in 1914 voted flat uniform 3-cent rate. Old rate still prevails under the law.

Cincinnati.—All steam. Load factor rate based on hours use of 70 per cent connected load. Base 10 cents per kilowatt hour, 40 hours use, $9\frac{1}{4}$ cents; 90 hours use, 7 cents; 180 hours use, $5\frac{1}{2}$ cents; 270 hours use, 5 cents. No free lamp renewals; no discount. Minimum charge $1. State commission has no jurisdiction over rates in first instance.

St. Louis.—Keokuk water power, steam auxiliary. Nine and one-half cents net per kilowatt hour. Residence Wright demand, room basis, 10 cents per kilowatt hour first 4 kilowatt hours for each of first four rooms plus 2½ kilowatt hours for each additional room; 6 cents for excess used. Minimum $1 per month; discount 5 per cent; free lamps. Rate ordinance fixed by state commission at 9½ cents upset by court. Company voluntarily reduced rates to maximum fixed by the commission. State commission has not regulated.

Kansas City.—All steam. Nine cents per kilowatt hour; no discount; minimum charge $1 per month. State commission has not regulated rates, but city appealed to commission to fix rates.

Denver.—Water power, steam auxiliary. Doherty rate, customer charge $9 per year; demand charge $36 per year per kilowatt connected; energy charge 5 cents per kilowatt hour; discount 10 per cent. Free lamps.

Rate schedules in detail.—Below are given in greater detail the typical rates of some other cities which illustrate the general practice in different parts of the country. The information is from the Rate Research, a publication issued by the National Electric Light Association and devoted to the compilation of this class of data.

Omaha, Nebr.—The Omaha Electric Light & Power Co.
Green Bay, Wis.—Green Bay Gas & Electric Co.
Norristown and Conshohocken, Pa.—The Counties Gas & Electric Co.
Superior, Wis.—The Superior Water Light & Power Co.
Madison, Wis.—Madison Gas & Electric Co.
Watertown, N. Y.—The Watertown Light & Power Co.
Pittsfield, Mass.—Pittsfield Electric Co.
Evansville, Ind.—The Evansville Public Service Co.
Meadville, Pa.—People's Incandescent Light Co.
Southern California.—Southern California Edison Co.
Bridgeport, Conn.—The United Illuminating Co.
Idaho.—Utah Power & Light Co.
Brooklyn, N. Y.—The Flatbush Gas Co.
New Glarus, Wis.—New Glarus Municipal Electric Light and Water Plant.
Hartford, Conn.—Hartford Electric Light Co.
Marquette, Mich.—Light and Power Commission.
Marshall, Mich.—Electric and Water Works Department.

OMAHA, NEBR.—The Omaha Electric Light & Power Co. has published the following lighting rate (effective July 1, 1913) and power rate (effective Oct. 1, 1913):

LIGHTING RATE.

Character of service.—Effective for commercial and residence lighting. The secondary lighting rate of 6 cents per unit (k w h.) is effective for all electrical heating devices and the charging of storage batteries designed for use in electric vehicles.

Rate.—Twelve cents per kilowatt hour for the first 30 hours' use per month of maximum demand; 6 cents per kilowatt hour for excess use.

Determination of demand.—Commercial lighting: Active load, 100 per cent of total connected load. Residence lighting: Active load, 60 per cent of total connected load.

Prompt payment discount.—Five per cent discount on total bill if paid within 10 days from date.

Minimum charge.—For regular service, none. For emergency or throw-over service, $1 per month per kilowatt of capacity connected to the service lines, and for no less a period than one year.

Lamp renewals.—Standard carbon or gem incandescent lamps will be furnished and renewed only on customer's premises without additional charge (to customers entitled to free lamp renewals) in standard sizes of 4 c. p. 20 watts, 10 c. p. 30 watts, 16 c. p. 50 watts, 32 c. p. 100 watts, either clear or frosted.

RETAIL POWER RATE.

Rate.—Nine cents gross per kilowatt hour for the first 200 kilowatt hours per month; 5 cents net per kilowatt hour for the next 400 kilowatt hours per month; 3 cents net per kilowatt hour for the next 2,600 kilowatt hours per month; 2 cents net per kilowatt hour for all excess kilowatt hours per month.

Discount.—One cent per kilowatt hour on first 200 if paid within 10 days from date.

Minimum charge.—For regular service, $3 per month. For emergency service or throw-over service, $1 per kilowatt of capacity connected to the service lines, and for no less a period than one year.

WHOLESALE POWER RATE.

Character of service.—This rate is designed to apply to large industrial enterprise using 3-phase 60-cycle alternating current and requiring long hours' use of power apparatus (where the guarantee of a minimum income of $140 per month to the company is warranted under a long term contract).

Rate.—Demand charge: $1.25 per month per kilowatt of capacity connected, for installations of over 150 horsepower. Energy charge: One cent per kilowatt hour.

Determination of demand.—The demand is considered as the total of capacity connected.

Discounts.—None.

Minimum charge.—One hundred and forty dollars per month.

GREEN BAY, WIS.—City of Green Bay *v.* Green Bay Gas & Electric Co., decision of the Wisconsin Railroad Commission, establishing gas and electric rates, July 11, 1913. The electric rates fixed by the commission are as follows:

GENERAL LIGHTING RATE.

For all lighting service furnished residences, business places, and public buildings including incidental use of appliances for heating and power measured by the same meter:

Rate.—Ten cents net or eleven cents gross per kilowatt hour for the first 30 kilowatt hours per month per active kilowatt connected. Eight cents net or nine cents gross per kilowatt hour for the next 60 kilowatt hours per month per active kilowatt connected. Four cents net or five cents gross per kilowatt hour for all use in excess of 90 kilowatt hours per month per active kilowatt connected. For all signs, outlines, and window lighting on a yearly contract basis five cents net or six cents gross per active 50-watt lamp or its equivalent per month plus four cents net or five cents gross per kilowatt hour for current consumed as estimated according to the schedule of lighting hours.

Determination of active connected load.—The active load shall be determined as ordered for Class A, B, C, E, and F in In re Madison Gas & Electric Co. (7 W. R. C. R. 152, 167).

Minimum charge.—One dollar net or $1.10 gross per month per meter.

Prompt payment discount.—The difference between the gross and net rates shall constitute a discount for prompt payment of bills.

Terms and conditions.—For the reconnection of meters for the same consumer on the same premises, a charge of $1 per meter shall be made. Where the company is unable to read meter, after reasonable effort, the fact shall be plainly indicated on the monthly bill, the minimum charge shall be assessed and the differences shall be adjusted with the consumer when meter is again read.

NORRISTOWN AND CONSHOHOCKEN, PA.—The Counties Gas & Electric Co. rates, effective December 31, 1913:

NORRISTOWN AND CONSHOHOCKEN.

Electric lighting.

Rate.—Ten cents per kilowatt hour for the first 200 kilowatt hours per month; 7 cents per kilowatt hour for the next 50 kilowatt hours per month; 5 cents per kilowatt hour for the next 100 kilowatt hours per month; 4 cents per kilowatt hour for over 350 kilowatt hours per month.

Discount.—Bills to be rendered at 1 cent per kilowatt hour above the foregoing rates and subject to a discount of 1 cent per kilowatt hour if paid at the office of the company within 10 days after presentation.

Minimum charge.—One dollar and fifty cents per meter per month.

Electric power.

Rate.—Ten cents per kilowatt hour for the first 100 kilowatt hours per month; 7 cents per kilowatt hour for the next 100 kilowatt hours per month; 6 cents per kilowatt hour for the next 100 kilowatt hours per month; 5 cents per kilowatt hour for the next 100 kilowatt hours per month; 4 cents per kilowatt hour for the next 400 kilowatt hours per month; 3 cents per kilowatt hour for the next 500 kilowatt hours per month; 2 cents per kilowatt hour for over 1,300 kilowatt hours per month.

Discount.—Bills to be rendered at 1 cent per kilowatt hour above the foregoing rates and subject to a discount of 1 cent per kilowatt hour if paid at the office of the company within 10 days after presentation. When the current consumption for any month computed at the aforesaid rates exceeds $75, the consumer shall be entitled to a further discount at 10 per cent thereon, provided the amount of such further discount shall not reduce the amount due for such consumption to an amount less than $75.

Supplementary discount.—No. 1: Where the company supplies the consumer with electric energy at the primary voltage of its distribution line, and the consumer furnishes the necessary transformers, a further discount of 5 per cent will be allowed from the monthly bill, figured at the aforesaid rate.

No. 2: If the power factor on the entire load, due to a lagging current is maintained at 95 per cent or better, a further discount of 5 per cent will be allowed on bills figured at the aforesaid rate.

Minimum charge.—No bill submitted on this schedule less than $2. If the connected load of a consumer is more than 2 horsepower the minimum charge shall be $1 per horsepower for all connected load.

MAIN LINE.

The following rates apply to consumers on company's distribution lines suitable for supplying service demanded:

Electric lighting.

Rate.—Ten cents per kilowatt hour for the first 200 kilowatt hours per month; 7 cents per kilowatt hour for the next 50 kilowatt hours per month; 5 cents per kilowatt hour for the next 100 kilowatt hours per month: 4 cents per kilowatt hour for over 350 kilowatt hours per month.

Minimum charge.—One dollar per meter per month.

Electric power.

Rate.—Ten cents per kilowatt hour for 100 kilowatt hours per month; 9 cents per kilowatt hour for 101 to 300 kilowatt hours per month; 8 cents per kilowatt hour for 301 to 600 kilowatt hours per month; 7 cents per kilowatt hour for 601 to 1,000 kilowatt hours per month; 6 cents per kilowatt hour for 1,001 to 1,500 kilowatt hours per month; 5 cents per kilowatt hour for 1,501 to 2,000 kilowatt hours per month, 4 cents per kilowatt hour for 2,001 to 2,500 kilowatt hours per month; 3 cents per kilowatt hour for over 2,500 kilowatt hours per month; 2½ cents per kilowatt hour for 10,000 or more kilowatt hours per month.

Minimum charge.—No bill submitted under this schedule less than $1. If the connected load of a consumer is more than 1 horsepower the minimum charge shall be $1 per horsepower for all connected load.

CONSHOHOCKEN.

Demand rate.—Ten cents per kilowatt hour for the first 20 kilowatt hours per month per horsepower; 6 cents per kilowatt hour for the first 100 kilowatt hours per month in excess of the above; 4 cents per kilowatt hour for the next 900 kilowatt hours per month; 2½ cents per kilowatt hour for over 1,000 kilowatt hours per month.

Rating of demand.—Under 10 horsepower demand, connected load; from 10 horsepower to 50 horsepower in one motor, 90 per cent connected load; from 10 horsepower to 50 horsepower in more than one motor, 80 per cent connected load. Over 50 horsepower demand obtained from curve-drawing instruments, when the demand will be taken as the highest average demand during any five consecutive minutes during the month.

Minimum charge.—No bill submitted on this schedule less than $1.

SUPERIOR, WIS. (population 40,384).—The Superior Water, Light & Power Co. rates, effective January 1, 1914, are as follows·

RESIDENCE LIGHTING RATE.

For all electric energy furnished residences, dwellings, flats, and private boarding houses for lighting. This service may include energy for other uses than lighting, where appliances of not over 600 watts capacity, each, are employed, whose aggregate demand does not require special wiring or enlarged meter or transformer capacity.

Rate.—Ten and one-half cents per kilowatt hour for all or part of first 6 kilowatt hours used per month in house having 3 rooms or less, plus 2 kilowatt hours for each additional room; 8½ cents per kilowatt hour for all or part of next 6 kilowatt hours used per month in house having 3 rooms or less, plus 3 kilowatt hours for each additional room; 6 cents per kilowatt hour for all energy used in excess of 12 kilowatt hours per month in house having 3 rooms or less, plus 5 kilowatt hours for each additional room.

Determination of rooms.—In applying the above rate, the count of rooms is to be made on the so-called real estate agents' rental basis (which excludes bathrooms, hallways, and unfinished attics and basements), except that rooms having an area of more than 300 square feet will count as two rooms. Where two or more rooms exceed 300 square feet each, only one extra room will be counted for each 300 square eet of excess area.

Minimum charge.—One- to 5-room house or flat, 50 cents, plus 10 cents for each additional room.

The following is a tabulation of above rate:

NUMBER OF ROOMS.	1–3	4	5	6	7	8	9	10	11	12	13	Add for each additional room.
	KILOWATT HOURS.											
Rate per kilowatt hour:												
10½ cents, first.	6	8	10	12	14	16	18	20	22	24	26	2
8½ cents, next.	6	9	12	15	18	21	24	27	30	33	36	3
6 cents, all over	12	17	22	27	32	37	42	47	52	57	62	5
Minimum monthly bill	$0.50	$0.50	$0.50	$0.60	$0.70	$0.80	$0.90	$1.00	$1.10	$1.20	$1.30	$0.10

Prompt payment discount.—One cent per kilowatt hour when paid on or before 10 a. m. on 16th and one-half cent per kilowatt hour when paid later than this, but not later than 10 a. m. on the 26th of month following that for which bill is rendered. When the 15th or 16th falls on a Sunday or holiday, discounts allowed until 10 a. m. on the 17th; and until 10 a. m. on the 27th, when the 25th or 26th falls on a Sunday or holiday.

Lamp renewals.—Lamps may be purchased from the company at prices as published. No allowance for lamps returned. The company assumes no responsibility for lamps after they have been delivered to the consumer.

Term of contract.—This agreement shall remain in force for the term stated, if any, and in any event, for the full period during which service is taken and until three days after receipt at the company's office of written notice from the consumer of his wish to discontinue. A term contract may be required when special investment is required in order to furnish service.

Terms and conditions.—When electric mains pass in front of a house, a charge of $5 is made for the labor cost of running service wires. When two or more houses are connected at the same time, by extending a single service drop from house to house and when the distance between the houses is less than 20 feet, the charges are as follows: Two houses, $7.50; three houses, $9; four houses, $10; five houses, $11.

COMMERCIAL LIGHTING RATE.

This service may include energy for other uses than lighting when motors or other appliances of not over 750 watts capacity each and not over 1,500 watts aggregate capacity are used.

Rate.—Ten and one-half cents per kilowatt hour for all or part of first 3 kilowatt, hours used per month per 100 watts of active load; 8½ cents per kilowatt hour for all, or part of next 6 kilowatt hours used per month per 100 watts of active load; 6 cents per kilowatt hour for all current used in excess of 9 kilowatt hours per month per 100 watts of active load.

Determination of active connected load.—Active connected load shall in every case be a percentage of total connected load consisting of lamps, appliances, etc., installed upon consumers' premises, and shall be fixed as follows:

Class A: Window, sign, basement salesroom, and outside decorative lighting, 66⅔ per cent of the total connected load shall be deemed active.

Class B: Stores, offices, etc., 70 per cent of the total connected load shall be deemed active when such load is equal to or less than 2½ kilowatts; 55 per cent of such connected load over and above 2½ kilowatts shall be deemed active, provided that lamps used exclusively in space devoted to the storing of goods shall be treated as 20 per cent active and shall not be included in the 2½ kilowatts specified above.

Class C: Public buildings, churches, hotels, factories, 55 per cent of the total connected load shall be deemed active.

In classes A, B, and C, the minimum connected load to be used in figuring active load shall be 200 watts.

Prompt payment discount.—Same as for residence lighting.

Note: On bills owed by the United States of America, the State of Wisconsin, the county of Douglas, and the city of Superior, an additional 30 days' time is allowed without forfeiture of discount.

Quantity discounts.—First 250 kilowatt hours per month, discount, none; second 250 kilowatt hours per month, discount, 0.5 cent per kilowatt hour; third 250 kilowatt hours per month, discount, 1 cent per kilowatt hour; fourth 250 kilowatt hours per month, discount, 1.5 cents per kilowatt hour; fifth 250 kilowatt hours per month discount, 2 cents per kilowatt hour; sixth 250 kilowatt hours per month, discount, 2.5 cents per kilowatt hour; seventh 250 kilowatt hours per month, discount, 3 cents per kilowatt hour; all additional consumption, discount 1.5 cents per kilowatt hour. The average discounts are as follows: Monthly consumption of 500 kilowatt hours, average discount, 0.25 cent per kilowatt hour; monthly consumption of 750 kilowatt hours, average discount, 0.5 cent per kilowatt hour; monthly consumption of 1,000 kilowatt hours, average discount, 0.75 cent per kilowatt hour; monthly consumption of 1,250 kilowatt hours, average discount, 1 cent per kilowatt hour; monthly consumption of 1,500 kilowatt hours, average discount, 1.25 cents per kilowatt hour; monthly consumption of 1,750 kilowatt hours and over, average discount, 1.5 cents per kilowatt hour.

Minimum charge.—Net 50 cents per month for 500 watts or less of connected load, plus 5 cents for each additional 50 watts connected.

Lamp renewals.—Same as for residence lighting.

Term of contract.—Same as for residence lighting.

MADISON, WIS. (population 25,531).—The Madison & Gas Electric Co. rate schedule as of November 30, 1913:

GENERAL LIGHTING RATE.

Rate.—Eleven cents gross or 10 cents net per kilowatt hour for the first 30 hours' use per month of active connected load; 7 cents gross or 6 cents net per kilowatt hour for the next 60 hours' use per month of active connected load; 3 cents gross or 2 cents net per kilowatt hour for all excess use per month of active connected load.

Determination of active connected load.—Active connected load shall in each case be a fixed percentage of the total connected load, consisting of lamps, appliances, etc., installed upon the consumers' premises.

Prompt payment discount.—The difference between the gross and net rates or 1 cent per kilowatt hour shall constitute a discount for payment before the 13th day of the month following the last day of meter reading.

Minimum charge.—One dollar net per month per meter.

Lamp renewals.—Company shall renew burned-out or badly dimmed carbon filament lamps of the type originally furnished or installed by the company when returned unbroken to its office. Charges for the maintenance and replacement of other illuminants shall be reasonable and in accordance with the schedule of charges filed with the railroad commission.

Terms and conditions.—For the reconnection of meters for the same consumer upon the premises a charge of $2 is deemed reasonable.

POWER RATES.

To any single consumer signing the company's standard forms of contract provided for service for three years or more and located within the residence districts adjacent to the company's 3-phase A. C. power lines, the charge for A. C. electric power service shall be computed upon the following basis:

Rate.—Demand charge: Twenty-eight dollars per year for each kilowatt of demand of the first 10 kilowatts; $18 per year for each kilowatt of demand of the next 90 kilowatts; $9 per year for each kilowatt of demand in excess of 100 kilowatts.

Energy charge: Two and one-half cents gross or 2 cents net per kilowatt hour for the first 500 kilowatt hours consumed during the month; 1½ cents gross or 1 cent net per kilowatt hour for the next 1,000, kilowatt hours consumed during the month; 1 cent gross or ¾ cent net per kilowatt hour for all energy consumed during any month in excess of 1,500 kilowatt hours.

WATERTOWN, N. Y. (population 26,730).—The Watertown Light & Power Co. schedule revised as of January 1, 1914.

LIGHTING RATES.

Rate.—Rates are named varying with hours and tenths of hours use per month from 11 cents gross, per kilowatt hour, for the first hours' use of consumer's demand, to 7.5 cents gross, per kilowatt hour for 8 hours' use of consumer's demand, 7 cents gross, per kilowatt hour for 13 hours' use of consumer's demand, and 6.3 cents gross, per kilowatt hour for 24 hours' use of consumer's demand, etc.

Determination of assessed demand.—The consumer's demand is assessed from an inspection of the consumer's lamps and appliances connected and use is made of the following table when watts consumption is not marked on label or name plate: Two candlepower carbon lamps, 13 watts; 4 candlepower carbon lamps, 22 watts; 8 candlepower carbon lamps, 32 watts; 10 candlepower carbon lamps, 35 watts; 16 candlepower carbon lamps, 56 watts; 20 candlepower carbon lamps, 70 watts; 24 candlepower carbon lamps, 84 watts; 32 candlepower carbon lamps, 112 watts; empty-sockets that may be used, 40 watts; inclosed arc lamps, 550 watts. Three-fourths of the whole connected load as obtained is taken as the basis on which to render bills with a minimum connected load of one-half kilowatts.

Quantity discounts.—Ten per cent discount on bills amounting to from $50 to $75 per month; 15 per cent discount on bills amounting to from $75.01 to $100 per month; 20 per cent discount on bills amounting to from $100.01 to $125 per month; 25 per cent discount on bills amounting to from $125.01 to $150 per month; and 30 per cent discount on bills amounting to over $150 per month.

Prompt payment discount.—A discount of 2 cents per kilowatt hour is allowed if bills are paid on or before the discount date named on the bill.

Minimum charge.—One dollar per month per consumer.

Terms and conditions.—Two or more business places owned by the same person or company will be considered as one in rendering bills if so desired, but in such cases the total connected load will be used as a basis instead of three-fourths of the connected load. Anyone who owns and uses a lighting plant and requires connection to our system will be charged a minimum of $1 per month per kilowatt connected load as a breakdown service charge.

PITTSFIELD, MASS. (population 32,121).—The following is the rate schedule of the Pittsfield Electric Co.:

RESIDENCE LIGHTING RATE.

Rate.—Twelve cents per kilowatt hour for the first kilowatt hour used per month per 25-watt lamp connected; 8 cents per kilowatt hour for all excess use. The minimum capacity that will be provided is 500 watts.

Prompt payment discount.—Ten per cent discount is allowed on bills if paid on or before the 15th of the month in which the bill is rendered, provided there exists no unpaid balance of previous months.

Minimum charge.—For any month that the meter for lighting service does not register at least 8 kilowatt hours, no bill for current will be rendered, but a net charge of 50 cents for maintenance of service will be made. If in any 12 consecutive months ending January 1 the consumption of electricity at regular rates, less discount equals $9 or more, a rebate will be made of amounts paid for maintenance of service as specified above.

Terms and conditions.—For each meter installed where customer is not on the company's books, a deposit will be required equal to one month's bill, or $3 for residence. The company will pay 4 per cent interest on same annually, deposit to be returned when the meter is removed.

COOKING RATES.

To encourage the use of electric flatirons, ranges, and other household appliances, the company recommends the installation of a special heating circuit so that the current used by these devices may be registered on a separate meter.

Rate.—Four cents per kilowatt hour is made a special flat rate for this class of service.

Minimum charge.—A minimum charge of $1 per month is required.

COMMERCIAL LIGHTING RATE.

For stores and places of business in congested section of city:

Rate.—Twelve cents per kilowatt hour for the first 30 hours' use per month of consumer's demand; 8 cents per kilowatt hour for the next 50 hours' use per month of consumer's demand; 6 cents per kilowatt hour for the next 100 hours' use per month of consumer's demand; 5 cents per kilowatt hour for all over 180 hours' use per month of consumer's demand.

Determination of demand.—Connected load not in excess of 1, 2, 3.5, 5, 7.5, 10, 15, 20, 25, 30, 40, or 50 kilowatts. Basis of demand, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, or 15 kilowatts. The minimum capacity that will be provided is 1 kilowatt.

Prompt payment discount.—Same as in residence lighting.

Terms and conditions.—For each meter installed where customer is not on the company's books, a deposit will be required equal to one month's bill, or $5 per store.

EVANSVILLE, IND. (population 69,647).—The Evansville Public Service Co. schedule taking as the maximum rate 7½ cents per kilowatt hour, prescribed as the rate for light and power in the franchise rendered the company, made effective the following rates January 1, 1913:

RESIDENCE LIGHTING RATES.

Rate.—Seven and one half cents per kilowatt hour for the first 100 kilowatt hours consumed per month; 7 cents per kilowatt hour for the next 100 kilowatt hours; 6½ cents per kilowatt hour for the next 100 kilowatt hours; 6 cents per kilowatt hour for the next 100 kilowatt hours; 5½ cents per kilowatt hour for the next 100 kilowatt hours; 5 cents per kilowatt hour for the next 100 kilowatt hours; 4½ cents per kilowatt hour for the next 100 kilowatt hours; 4 cents per kilowatt hour for the next 100 kilowatt hours; 3¾ cents per kilowatt hour for all over 800 kilowatt hours consumed per month.

Prompt payment discount.—Ten per cent if bill is paid on or before the 12th day of the month succeeding that month for which bill is rendered.

Minimum charge.—One dollar net per consumer per month.

COMMERCIAL LIGHTING RATES.

Regular Rate.

Same schedule as for residence lighting.

Optional Rate.

Under this schedule, stores and commercial establishments of every character will be billed, if they so elect by contract for lighting service.

Rate.—Fixed charge plus energy charge. Fixed charge: Two dollars and fifty cents net or $2.77 gross per active kilowatt per month.

Energy charge: Three cents net or 3⅓ cents gross per kilowatt hour for the first 90 hours' use per month of active connected load; 2 cents net or 2.22 cents gross per kilowatt hour for all energy use in excess of 90 hours' use per month of the active connected load.

Determination of active connected load.—Class A: Banks, office buildings, professional establishments, wholesale and retail merchandise establishments, etc., the following percentage of the connected load shall be deemed active: 90 per cent of the first 2 kilowatts, 80 per cent of the next 3 kilowatts, 60 per cent of all over 5 kilowatts.

Class B: Department stores, hotels and office buildings where company sells service to the building as one customer, but not including stores on the first floor, the following per cent of the connected load shall be deemed active: 70 per cent of the first 5 kilowatts, 50 per cent of the next 5 kilowatts, 30 per cent of all over 10 kilowatts.

Class C: Vaudeville theaters, moving-picture shows, etc., the following percentage of connected load shall be deemed active: 60 per cent of the first 5 kilowatts, 40 per cent of all over 5 kilowatts.

For 40-week theaters, 33⅓ per cent of connected load, and for summer parks, and all similar transient customers, 100 per cent of the connected load, shall be deemed active.

Prompt payment discount.—The difference between the gross and net rates will constitute a discount for prompt payment on bills paid on or before the twelfth day of the month.

POWER RATES.

Regular Rate.

Rate.—Five cents per kilowatt hour for the first 300 kilowatt hours per month; 4½ cents per kilowatt hour for the next 300 kilowatt hours per month; 4 cents per kilowatt hour for the next 300 kilowatt hours per month; 3½ cents per kilowatt hour for the next 300 kilowatt hours per month; 3 cents per kilowatt hours for the next 300 kilowatt hours per month; 2½ cents per kilowatt hour for all over 1,500 kilowatt hours per month.

Prompt payment discount.—Ten per cent if bill is paid on or before the 12th day of the month succeeding the month for which bill is rendered.

Minimum charge.—Fifty cents net per horsepower connected per month.

Optional Rate.

Rate.—Fixed charge plus energy charge. Fixed charge: Two dollars net or $2.22 gross per active kilowatt per month.

Energy charge: One cent net or 1.11 cents gross per kilowatt hour for all current consumed.

Prompt payment discount.—Same as in regular rate.

Additional 50 per cent discount from fixed charge allowed for off-peak power users.

Active connected load.—The following percentage of total nominal rated capacity of motor or motors installed shall be deemed active: ninety per cent of the first 5 horsepower of connected load, 80 per cent of the next 5 horsepower of connected load, 70 per cent of the next 20 horsepower of connected load, 60 per cent of the next 20 horsepower of connected load, 50 per cent of all over 50 horsepower of connected load.

Meadville, Pa. (population 12,780).—The following is the rate schedule of the Peoples' Incandescent Light Co., effective January 1, 1914:

RETAIL LIGHT SERVICE.

Available for and applying to all consumers using the company's standard lighting service, applicable especially to residence lighting and other lighting service where average monthly consumption is low.

Rate.—Ten cents per kilowatt hour.

Prompt payment discount.—Discount of 10 per cent if paid on or before the 10th day of each month.

Minimum charge.—One dollar per month per consumer.

Terms and conditions.—A cash deposit of $3 will be required with each service application when customer is not a property owner, or when monthly service charges are not guaranteed by a responsible party. The company reserves the right to discontinue service in case of failure of customer to make prompt payment of bills when due, or in case of violation of the rules and regulations of the company governing use of the electric service.

WHOLESALE LIGHTING SERVICE.

Available for and applying to all consumers using the company's standard lighting service, and especially applicable to commercial lighting and other lighting service where average monthly consumption warrants a minimum charge of $2.

Rate.—Ten cents per kilowatt hour for the first 10 kilowatt hours per month; 8 cents per kilowatt hour for the next 20 kilowatt hours per month, 6 cents per kilowatt hour for the next 70 kilowatt hours per month, 5 cents per kilowatt hour for the next 900 kilowatt hours per month, 4 cents per kilowatt hour for all over 1,000 kilowatt hours per month.

Prompt payment discount.—Discount of 5 per cent if paid on or before the 10th day of each month.

Minimum charge.—Two dollars per month per consumer.

Terms and conditions.—Same as in retail lighting service except that $5 is required as a cash deposit.

SIGN AND WINDOW LIGHTING.

Available for consumers using the company's standard lighting service for sign, window, and display lighting. This service is turned on and off by the company and will be operated between dusk and 11 p. m. each day.

Rate.—One cent per watt per month for each watt installed.

Prompt payment discount.—Five per cent if paid on or before 10th day of each month.

Minimum charge.—One dollar per month per consumer.

Terms and conditions.—Same as for retail lighting service.

COOKING AND HEATING SERVICE.

Available for all consumers using the company's standard service for heating and cooking purposes and offering a special low rate to consumers desiring to use electric cooking utensils and heating devices.

Rate.—Four cents per kilowatt hour.

Prompt payment discount.—Five per cent if paid on or before the 10th day of each month.

Minimum charge.—One dollar per month per consumer.

Terms and conditions.—Same as for retail lighting service.

GENERAL POWER SERVICE.

Available for all power consumers using the company's standard service.

Rate.—Unit charge: Five cents per kilowatt hour for all use less than 250 kilowatt hours per month; 4½ cents per kilowatt hour for 250 kilowatt hours per month; 4 cents per kilowatt hour for 500 kilowatt hours per month; 3½ cents per kilowatt hour for 1,000 kilowatt hours per month; 2½ cents per kilowatt hour for 2,000 kilowatt hours per month; 2¼ cents per kilowatt hour for 3,000 kilowatt hours per month; 2 cents per kilowatt hour for 5,000 kilowatt hours per month; 1¾ cents per kilowatt hour for 10,000 kilowatt hours per month; 1½ cents per kilowatt hour for 20,000 kilowatt hours per month. For amounts between those named above, charge will be made at rate given for next larger amount. Demand charge: Where unit consumption exceeds 2,000 kilowatt hours per month a monthly charge of $1 per kilowatt demand will be made in addition to unit charge as named above.

Determination of demand.—Where installation does not exceed 15 kilowatts the maximum monthly demand will be the actual installed demand. Where installation exceeds 15 kilowatts the maximum monthly demand will be determined by maximum demand meters.

Prompt payment discount.—Five per cent if paid on or before the 10th day of each month.

Minimum charge.—One dollar per month per kilowatt demand, provided that in no case an amount will be charged less than $2.

Terms and conditions.—A cash deposit of $10 will be required with each service application when the customer is not a property owner or when monthly service charges are not guaranteed by a responsible party.

RESERVE OR BREAKDOWN SERVICE.

Rate.—In accordance with previous schedules herein named as conditions and requirements of consumers may demand.

Minimum charge.—One dollar per month per kilowatt of installed demand.

Terms and conditions.—Same as for general power service.

Southern California.—The Southern California Edison Co. has filed with the California Railroad Commission a new schedule for electric lighting service which applies in Los Angeles, Riverside, San Bernardino, and Orange Counties, except in the cities of Los Angeles and Pasadena. This schedule becomes effective March 1, 1914.

Rate.—Seven cents per kilowatt hour for the first 100 kilowatt hours per month; 6½ cents per kilowatt hour for the next 200 kilowatt hours per month; 6 cents per kilowatt hour for the next 200 kilowatt hours per month; 5½ cents per kilowatt hour for the next 500 kilowatt hours per month; 5 cents per kilowatt hour for the next 1,000 kilowatt hours per month; 4 cents per kilowatt hour for the next 1,000 kilowatt hours per month; 3 cents per kilowatt hour for the next 2,000 kilowatt hours per month; 2½ cents per kilowatt hour for all over 5,000 kilowatt hours per month.

Minimum charge.—One dollar per month.

Lamp renewals.—Free renewals of Gem metalized filament lamps of 8-candlepower and over.

Bridgeport, Conn. (population 102,054).—The United Illuminating Co. now charges the following rates for electric light and power:

LIGHTING RATES.

Rate.—Eight cents per kilowatt hour.

Quantity discounts.—Five per cent less for 400 kilowatt hours or more per month; 10 per cent less for 600 kilowatt hours or more per month; 15 per cent less for 800 kilowatt hours or more per month; 20 per cent less for 1,600 kilowatt hours or more per month; 25 per cent less for 2,400 kilowatt hours or more per month; 30 per cent less for 3,200 kilowatt hours or more per month; 35 per cent less for 4,000 kilowatt hours or more per month.

Minimum charge.—Twelve dollars per year per meter.

Lamp renewals.—The above rate includes free renewal of standard Gem metalized filament lamps.

POWER RATES.

Rate.—Six cents per horsepower hour for less than 50 horsepower hours per month; 5 cents per horsepower hour for 50 horsepower hours or more per month 4.5 cents for 100 or more; 4.25 cents for 200 or more; 4 cents for 400 or more; 3.75 cents for 600 or more; 3.5 cents for 800 or more; 3.3 cents for 1,200 or more; 3.1 cents for 1,600 or more; 2.9 for 2,400 or more; 2.7 cents for 3,600 or more; 2.5 cents for 4,800 or more; 2.3 cents for 6,000 or more; 2.1 cents for 8,000 or more; 1.9 cents for 10,000 or more; 1.8 cents for 15,000 or more; 1.7 cents for 20,000 or more; 1.6 cents for 30,000 or more; and 1.5 cents per horsepower hour for 40,000 horsepower hours or more per month.

Minimum charge.—One dollar per month for ½ horsepower installed, $1.50 per month for 1 horsepower installed, $2 per month for 2 horsepower installed, $2.50 per month for 3 horsepower installed, $3 per month for 4 horsepower installed, $4 per month for 5 horsepower installed, $4 per month for 7½ horsepower installed, $5 per month for 10 horsepower installed, 50 cents per horsepower per month for all over 10 horsepower installed.

Idaho.—The Utah Power & Light Co. has put into effect in its Idaho territory the following schedule, effective March 1, 1914:

LIGHTING—METER RATE.

Rate.—Ten cents per kilowatt hour for the first 60 hours' use per month of customer's demand, 7 cents per kilowatt hour for all additional hours' use per month of customer's demand.

Determination of demand.—Customer's demand in the above shall be calculated as a percentage of the connected lighting load in accordance with the following classification:

Class 1: Any customer with less than five interior lights; also sign and outline lighting, displays, windows, hallways, and public lights of buildings (these are figured separately from the balance of the installation), 100 per cent.

Class 2: Art stores, banks, barber shops, bakeries, book stores, bowling alleys, cafés, cigar stores, clothing stores, clubs, coffee and tea stores, commission houses, confectionery stores, dance halls, department stores, dressmaking and millinery stores, drug stores, dry goods stores, florists, furniture stores, furnishings stores, groceries, hardware stores, hat stores, hotels and rooming houses, lodge halls, meat markets, moving-picture theaters, photographers' studios, public halls, railroad business, restaurants, saloons, shoe-shining parlors, shoe stores, telegraph and telephone business, theaters, wholesale liquor and wine stores, general stores, 85 per cent.

Class 3: Apartment houses, automobile stores and garages, bicycle and electrical shops, breweries, business offices, churches, cleaning and dyeing shops, engraving and printing shops, express companies, hospitals, jewelry stores, laundries, livery stables and barns, loan offices, manufactories, machine, carpenter and blacksmith shops, music and piano stores, paint shops, pool and billiard halls, public buildings, publishing establishments, residences, schools, tailor shops, undertakers' establishments, warehouses, wholesale houses, 70 per cent.

Prompt payment discount.—A discount of 10 per cent on all metered bills for retail lighting and retail power service will be given, provided such bills are paid in full on or before 10 days from date rendered; and provided further that no previous bills remain unpaid. Failure to receive bills will not entitle the customer to discount.

Minimum charge.—A minimum monthly charge of $1 net shall apply.

Terms and conditions.—The company will furnish the necessary meters which will be maintained by and remain the property of the company. Any meter registering within 2 per cent either way from normal is to be considered satisfactory. If the company's measuring instruments shall fail to register, the account for the period during which stoppage occurred, shall be made up and settled on the basis of previous days of like use. Property owners will ordinarily not be required to make any meter deposits covering electrical service to property owned and occupied by them. Customers occupying rented premises, even though they may own other property, will be required to pay a deposit covering the furnishings of electric service to the premises occupied, on the basis of an estimated 60 days' bill; it being understood, however, that for residential customers said deposit shall in no case be less than $2.50 nor greater than $5. The company will pay interest on meter deposits at the rate of 8 per cent per annum.

HEATING AND COOKING—METER RATE.

This schedule is for alternating current service supplied at 110, 220, or 440 volts, for heating and cooking purposes only, and measured by a separate meter.

Rate.—Four cents per kilowatt hour for the first 50 kilowatt hours of monthly consumption, 3 cents per kilowatt hour for all additional kilowatt hours of monthly consumption.

Prompt payment discount.—A discount of 10 per cent on all metered bills for retail lighting and retail power service will be given, provided such bills are paid in full on or before 10 days from date rendered; and provided further that no previous bills remain unpaid. Failure to receive bills will not entitle customer to discount.

Minimum charge.—A minimum monthly charge of $2 net shall apply.

Terms and conditions.—Same as in lighting, meter rate.

RETAIL POWER—METER RATE.

This schedule is for alternating current service supplied for power purposes only (including irrigation), for installations aggregating 50 horsepower or less, and measured by a single meter.

Rate.—For delivery at 110, 220, or 440 volts: Five cents per kilowatt hour for the first 60 hours' use per month of customer's connected load, 3 cents per kilowatt hour for all additional hours' use per month of customer's connected load.

For delivery at 2,300, 4,000, 6,600, or 11,000 volts: Four cents per kilowatt hour for the first 60 hours' use per month of customer's connected load, 2 cents per kilowatt hour for all additional hours' use per month of customer's connected load.

Prompt payment discount.—A discount of 10 per cent on all metered bills for retail lighting and retail power service will be given, provided such bills are paid in full on or before 10 days from date rendered, and provided further that no previous bills remain unpaid. Failure to receive bills will not entitle the customer to discount.

Minimum charge.—A minimum monthly charge of $1 net per horsepower of connected load shall apply.

Terms and conditions.—Same as in lighting, meter rate.

IRRIGATION POWER—FLAT RATE.

This schedule is for alternating current service supplied for irrigation power purposes only, for installations aggregating 50 horsepower or less.

Rate.—For delivery at 110, 220, or 440 volts: Five dollars per month per horsepower of customer's connected load.

For delivery at 2,300, 4,000, 6,600, or 11,000 volts: Four dollars and fifty cents per month per horsepower of customer's connected load.

Prompt payment discount.—A discount of 10 per cent on all metered bills for retail lighting and retail power service will be given, provided such bills are paid in full on or before 10 days from date rendered; and provided further, that no previous bills shall remain unpaid. Failure to receive bills will not entitle customers to receive discount.

Term.—Charges shall continue as long as customer's apparatus is connected to company's line or until company receives written notice to disconnect. This schedule is for a minimum period of three consecutive months per season.

Terms and conditions.—Same as in lighting, meter rate.

WHOLESALE POWER—METER RATE.

This schedule is for alternating current service supplied for power purposes only (including irrigation) for installations aggregating more than 50 horsepower and measured by a single meter of each kind needed.

Rate.—For delivery at 110, 220, or 440 volts: Demand charge, $1.33⅓ per month per kilowatt of customer's demand; energy charge, 1.8 cents per kilowatt hour.

For delivery at 2,300, 4,000, 6,600, or 11,000 volts: Demand charge, $1.33⅓ per month per kilowatt of customer's demand; energy charge, 1.5 cents per kilowatt hour.

For delivery at 44,000 volts: Demand charge, $1.33⅓ per month per kilowatt of customer's demand; energy charge, 1.3 cents per kilowatt hour.

Determination of demand.—Customer's demand in the above shall be determined by periodic tests, or by suitable permanent meters, or in any other mutually satisfactory manner.

Discounts.—The following quantity discounts on the total monthly bill shall apply: First $400 or fractional part thereof, net; next $400 or fractional part thereof, 15 per cent; next $400 or fractional part thereof, 30 per cent; all in excess of $1,200, 45 per cent.

Minimum charge.—A minimum monthly charge of $1 net per horsepower of connected load shall apply.

Brooklyn, N. Y.—The Flatbush Gas Co., Borough of Brooklyn (Twenty-ninth ward only), Greater New York, has been granted special permission by the New York Public Service Commision (first district) to put into effect seven days after publication a supplement to its schedule of rates for power purposes. In its application the company stated that it had a request from an ice manufacturer for the supply of electric current for power purposes in quantities so large that it was necessary to extend the old scale of discounts to make a rate for the prospective consumer. The present rate is:

Rate.—Twelve cents per kilowatt hour for first 800 kilowatt hours per month; 10 cents per kilowatt hour for from 800 to 1,200 kilowatt hours per month; 8 cents per kilowatt hour for from 1,200 to 2,000 kilowatt hours per month; 7 cents per kilowatt hour for excess over 2,000 kilowatt hours per month.

Discounts.—On monthly bills for 100 horsepower hours and over (less than 200), 20 per cent; 200 horsepower hours and over (less than 400), 25 per cent; 400 horsepower hours and over (less than 600), 30 per cent; 600 horsepower hours and over (less than 800), 35 per cent; 800 horsepower hours and over (less than 1,000), 40 per cent; 1,000 horsepower hours and over (less than 1,500), 45 per cent; 1,500 horsepower hours and over (less than 5,000), 50 per cent; 5,000 horsepower hours and over (less than 10,000), 55 per cent; 10,000 horsepower hours and over (less than 15,000), 60 per cent; 15,000 horsepower hours and over (less than 20,000), 65 per cent; 20,000 horsepower hours and over (less than 25,000), 70 per cent; 25,000 horsepower hours and over (less than 35,000), 75 per cent; 35,000 horsepower hours and over (less than 55,000), 80 per cent; 55,000 horsepower hours and over (less than 80,000), 81¼ per cent; 80,000 horsepower hours and over, 83⅓ per cent.

These discounts were already in use up to 55 per cent on monthly consumption of 5,000 horsepower hours and over. The new supplement authorized by the commission extends the sliding scale of discounts up to 83⅓ per cent, as above.

New Glarus, Wis.—Application of the New Glarus (population 708) Municipal Electric Light & Water Plant for authority to increase its rates. Decision of the Wisconsin Railroad Commission, increasing the rates, November 22, 1912. Application was made for permission to increase electric rates on the ground that the rate then in effect, which was a flat one of 8 cents per kilowatt hour, did not meet expenses. The commission made a valuation of the property and an analysis of the revenues and expenditures, also a careful apportionment as between the electric and water plants and between the different departments of electric service. All free service was ordered to be discontinued, and the following rates were established:

COMMERCIAL LIGHTING.

Rate.—Customer charge: Twenty-five cents per meter per month.

Energy charge: Eleven cents per kilowatt hour.

Prompt payment discount.—One cent per kilowatt hour for payment within 15 days.

COMMERCIAL POWER.

Demand charge.—One dollar per rated horsepower per month.

Prompt payment discount.—Twenty-five cents per rated horsepower for payment within 15 days.

Energy charge.—Six cents net per kilowatt hour for first 30 hours use of connected load per month, 4 cents net per kilowatt hour for excess over 30 hours use of connected load per month.

STREET LIGHTING.

Rate, to be credited to plant.—Fifty dollars per 640-watt arc per year, $25 per 250-watt tungsten lamp per year. (Moonlight schedule till 11 p. m., 1,100 hours annually.)

Hartford, Conn.—The schedule of the Hartford Electric Light Co., effective December 1, 1912, comprises a residence rate that is not available for business purposes, a cooking rate not available for power, and a power rate not available for cooking.

RESIDENCE LIGHTING.

Available for all consumers using the company's standard service.

Rate.—Nine cents per kilowatt hour.

Prompt payment discount.—Five per cent when bills are paid on or before 10 days after their respective dates.

Minimum charge.—None.

Lamp renewals.—The rate given above includes the renewal of standard metallized filament lamps and tungsten lamps of 250 watts and over, when burned-out lamps are returned unbroken.

Standard riders.—None given.

Term of contract.—None given.

Terms and conditions.—See contract form.

SCHEDULE A—RESIDENCE LIGHTING.

1. On meter.—Current for residence lighting will be furnished to customers signing contract embodying the company's terms and conditions at the rate of 9 cents per kilowatt hour, less 5 per cent for 10 days' cash payment.

2. Flat rate.—Customers may, at their option, sign a flat-rate contract for not less than one year for low-voltage tungsten lighting under the following schedule: Ten-candlepower lamps, $1 per month; each additional 10-candlepower lamp, 6 cents per month, less 5 per cent for 10 days' cash payment. Ten to 20 candlepower lamps, $1.50 per month; each additional 20-candlepower lamp, 12 cents per month, less 5 per cent for 10 days' cash payment.

SCHEDULE B—WHOLESALE LIGHTING.

On meter.—Current for commercial lighting will be furnished customers signing contract embodying company's terms and conditions according to the following schedule:

Monthly consumption.—For the first 500 kilowatt hours, 9 cents per kilowatt hour; for any part of next 1,000 kilowatt hours, 7 cents per kilowatt hour; for any part of next 2,500 kilowatt hours, 4 cents per kilowatt hour; for any part of next 6,000 kilowatt hours, 3½ cents per kilowatt hour; for all excess, 2½ cents per kilowatt hour.

Under this contract the following discounts from the gross bill for long-burning hours will be allowed: Thirty-five per cent for over 350 hours' use of installed load per month, 30 per cent for over 280 hours' use of installed load per month, 25 per cent for over 230 hours' use of installed load per month, 20 per cent for over 195 hours' use of installed load per month, 15 per cent for over 165 hours' use of installed load per month, 10 per cent for over 140 hours' use of installed load per month, 5 per cent for over 115 hours' use of installed load per month, 2 per cent for over 100 hours' use of installed load per month.

A further discount of 5 per cent for 10 days' cash payment will also be allowed.

Flat rate.—Flat-rate contract, based upon meter schedule and subject to revision at the expiration of one year, will be given to customers desiring to contract for a definite number of hours' use of installed load. This rate will include lamp renewals up to a normal amount for the contracted hours of burning.

SCHEDULE C—POWER.

Current for wholesale power purposes will be furnished to regular users of power upon signing contract embodying the company's terms and conditions according to the following schedule:

Monthly consumption.—For the first 500 kilowatt hours, 4½ cents per kilowatt hour; for any part of next 1,000 kilowatt hours, 3½ cents per kilowatt hour; for any part of next 3,500 kilowatt hours, 2¾ cents per kilowatt hour; for any part of next 65,000 kilowatt hours, 1½ cents per kilowatt hour; for all excess, 1⅓ cents per kilowatt hour.

These rates are for power only. Energy used directly or indirectly for lighting purposes must be metered separately, and billed at lighting rates, except that for any month when the energy used for power exceeds 90 per cent of the total the amount of energy used for lighting will be included with that for power, and the total billed at power rates.

SCHEDULE D—NIGHT POWER.

[Current used for power at night.]

In order to encourage the use of power at night any customer contracting for energy under either the power or cooking schedule, upon a guaranty of a minimum payment of $20 per month, for their night power, will be allowed a discount of 40 per cent on such a fraction of their total power as is used between the hours of 10 p. m. and 7 a. m. The company will install special meters for recording this power without charge, provided the demand for such night power amounts to at least 10 per cent of the total.

SCHEDULE E—COOKING.

The company will furnish energy for operating cooking and heating apparatus to customers signing contract embodying the company's terms and conditions at the rate of 3 cents per kilowatt-hour on a guaranteed minimum payment of $1 per month. This schedule may be used in residences to include such other household appliances as flatirons, cleaners, etc., as may be desired, in addition to the cooking apparatus contracted for.

SCHEDULE F—AUXILIARY SERVICE.

The company will maintain a service for supplying electric current as a reserve, auxiliary, or breakdown to a private generating plant, provided the customer guarantees a minimum monthly payment for this service of $3 per kilowatt per month for the first 25 kilowatts contracted for; $2 per kilowatt per month for the next 75 kilowatts contracted for; $1.50 per kilowatt per month for the next 100 kilowatts contracted for. Current will be delivered at customer's switchboard and billed monthly according to regular light or power schedules, subject to above minimum monthly payments. No lamp renewals are supplied under this schedule.

SCHEDULE G—SPECIAL APPLICATIONS.

In order to encourage novel uses of electric current, the company is prepared to investigate any proposed installations, and to quote low experimental rates thereon, subject to revision at the expiration of one year's contract.

MARQUETTE, MICH. (population 11,503).—Light and Power Commission. This is a large water-power plant, the full power available being greater than all present uses. The following new schedule of rates was put into effect March 1, 1913:

LIGHTING RATES.

Rate.—Five cents per kilowatt hour for first 200 kilowatt hours per month; 4 cents per kilowatt hour for next 100 kilowatt hours per month; 3 cents per kilowatt hour for next 100 kilowatt hours per month; 2 cents per kilowatt hour for excess over 400 kilowatt hours per month.

POWER RATES.

Rate.—Three cents per kilowatt hour for first 200 kilowatt hours per month; 2 cents per kilowatt hour for next 200 kilowatt hours per month; 1 cent per kilowatt hour for excess over 400 kilowatt hours per month.

STREET LIGHTING.

Rate.—Sixty dollars per year per 7.5-ampere inclosed arc lamp (all night schedule).

MARSHALL, MICH.—Electric and Water Works Department. The present electric rates are:

RESIDENCE LIGHTING.

Rate.—Five cents per kilowatt hour.
Prompt payment discount.—Ten per cent if paid within 16 days
Minimum charge.—Fifty cents per month.

COMMERCIAL LIGHTING.

Rate.—Four cents per kilowatt hour.
Prompt payment discount.—Ten per cent if paid within 16 days.
Minimum charge.—Fifty cents per month.

STREET LIGHTING.

Thirty-five dollars per 6.6-ampere arc light per year, $10 per tungsten light (average 68 watts), (all-night schedule).

STREET AND ELECTRIC RAILWAYS

Part I.—STATISTICAL.
Part II.—TECHNICAL.

STREET AND ELECTRIC RAILWAYS.

PART I.—STATISTICAL.

CHAPTER I.

INTRODUCTION AND GENERAL EXPLANATIONS.

Classes of railways included.—The statistics in this report represent all railways, other than steam roads, in operation during any portion of the year 1912, in continental United States. The canvass did not cover Alaska or the insular possessions. Comparative statistics are shown for the censuses of 1907, 1902, and 1890.

At the census of 1890 the term "street railways" was used in defining the scope of the inquiry. As a rule, the roads for which statistics were presented were those operated on the public streets and thoroughfares of urban districts, and electric traction represented less than one-sixth of the total mileage. At the census of 1902 the term "street and electric railways" was used, and the same designation was employed at the censuses of 1907 and 1912. Since 1902 there has been an extensive development of suburban and interurban electric railways, and by 1907 the track mileage outside of city limits constituted approximately two-fifths of the total track mileage covered by the inquiry. The scope of the inquiry has been materially increased by the electrification of steam roads which own their rights of way, and by the extension of suburban and interurban electric lines located largely on private rights of way. As at prior censuses, the report covers roads operated by cable power and by animal power; roads operating self-propelled cars using gasoline motors, gas-electric motors, and by storage batteries; and one road of a street railway character employing steam traction solely.

In 1912 there were 21 roads employing cable traction, 13 cable exclusively and 8 cable in conjunction with other power. The 13 exclusively cable roads comprise 2 street railway companies in San Francisco and 11 inclined-plane cable roads located 3 in California, 4 in Pennsylvania, and 1 each in Ohio, Minnesota, Virginia, and Tennessee. In 1890 cable roads were an important factor. The trackage then operated by cable power constituted 6 per cent of the total trackage. The inclined-plane cable roads were included as a feature of the cable systems, and have been carried along at the subsequent canvasses. The exclusively gasoline motor roads are located 2 in Georgia, 2 in Texas, and 1 each in the states of Massachusetts, Illinois, California, and Florida. The roads still operated by animal power exclusively are located 3 in Texas and 1 each in Maine, Indiana, Ohio, Kansas, Arkansas, and Nebraska. The longest has but 3 miles of track.

Electrically operated divisions of steam roads.—The statistics for electrically operated divisions of steam roads are included only in cases where full reports could be made therefor separately from those for the steam railroad operations. Some companies reported the same tracks as operated by both steam and electricity, and others that the traffic and operating statistics of an electrically operated branch did not permit of segregation from those pertaining to the main line operated by steam. Statistics for these roads are therefore not included in the general statistics for electric railways. There are also excluded from the general statistics the Chicago Tunnel Co., operating the system of narrow-gauge freight tunnels under the streets of Chicago, the Bingham Central Railway of Utah, a narrow-gauge electric tunnel road serving mines, and the road owned by the state of North Dakota, at Bismarck, and operated in connection with the state capital.

A summary of all electrically operated trackage as it existed at the close of the year 1912, including the electrified divisions of steam roads, the electrified terminals of the New York Central and Hudson River and the Pennsylvania systems, the electrified tunnels of the steam roads, and the two freight tunnel roads above referred to, will be found on page 205 of this report.

Municipal railways.—The only railways owned by municipalities in operation in 1912 were those owned by the city of Monroe, La., the North Dakota State Railway, above referred to, and the municipal railway of San Francisco. The first-named railway is regularly operated for public service and is included in this report. The municipal railway of San Francisco was constructed during 1912 and went into operation just before the close of the year (Dec. 24, 1912). In view of the fact that the Geary Street, Park & Ocean Railway, which it supplanted, was operated until May 5, 1912, and had to be included, as it was in operation during the year, the statistics for the municipal railway, although in operation for a few days within the year, were excluded.

Railway and nonrailway operations.—Many electric railway companies sell electric current for lighting and industrial purposes. When it was impossible to obtain complete separate reports for the railway and for the electric light and power department, the data for both branches were included in the report for the railway. Statistics of the income of such light and power departments of electric railways, and of the lamps wired for service, are shown in the report for central electric light and power stations, and there are given in that report the aggregate power statistics for the combined industries—central electric light and power stations and street and electric railways.

In some cases electric railway companies are engaged in other businesses, such as the manufacture of gas or ice, the distribution of natural gas, or the operation of a ferry, or have investments in other property not incident to the operation of a railway. When possible, the investments in such collateral enterprises are reported separately from the investments in railway property, and only the net income derived therefrom is reported as revenue. A notable instance where investment in nonrailway property is not separable from that in railway property is the case of the 22-story office buildings known as the Hudson Terminal Buildings of the Hudson & Manhattan Railroad of New York City, the subsurface and lower portions of which pertain to railway operations, while a large revenue is derived from office rentals. Bridge properties, tunnels, amusement parks and resorts, and turnpikes, which have been constructed or acquired by electric railway companies, are as a rule covered by the capitalization of the railways, and in such cases statistics therefor are included. There are several cases where properties of this character are owned by independent corporations and operated by the railway companies under lease or contract, and the capitalization and statistics of operation for these properties are included with those for the railways.

Period covered.—The reports, as a rule, are for the calendar year. Of the 975 operating companies, 817 submitted reports for the year ending December 31, 1912; 114 for the year ending June 30, 1912; 14 for fiscal years ending at other dates in 1912; and 30 for years extending into 1913. Every company that was in operation during any portion of the year is included, but the operations of 34 companies did not cover the full year. In 1907 there were 55 part-time companies.

It should be noted that in the preparation of Part II, which deals with the technical features of the industry, the account of improvements and developments in power plants, cars, equipment, etc., has been brought down to date of preparation (1914) and is not confined to conditions existing at the close of 1912.

Class of companies.—The companies are fundamentally classified as (1) operating companies, (2) nonoperating or lessor companies, and (3) holding companies.

Operating companies.—This class includes companies operating railways, whether the property be owned or leased. The 975 operating companies reported at the present census operated 41,064.82 miles of track, of which 33,416.86 miles was owned by the operating companies, 7,414.33 miles was leased, and 233.63 miles was operated under trackage rights from steam railroad companies. There were 26 companies in 1912, operating 2,576.45 miles, that did not own any track.

Lessor companies.—This class includes companies owning railway property leased to operating companies, in most cases under agreement providing for the payment of interest on the funded debt and fixed dividends on the stock of the lessor companies. There were 285 such companies in 1912.

Holding companies.—These are organized for the purpose of acquiring the stock and bonds of railways for the purpose of investment, though some of them control the operations of other properties. They may be divided into two classes—(*a*) incorporated companies duly organized as holding corporations; and (*b*) unincorporated associations managed by a board of trustees. There were 61 holding companies reported at the present census. They are largely, though not necessarily entirely, identified with railway interests. The line of demarcation between electric railway holding companies and holding companies controlling other public utility corporations is not clearly defined, and the group is largely a matter of selection.

Another phase of railway operations is represented by organizations which act as managers and do not own the roads or the stock of the operating companies. These are not within the scope of this report.

Basis of classification.—Operating companies are grouped under three main classifications in order that statistics may be presented for companies operating under similar conditions. The first is a classification according to size, based upon income from railway operations; the second, a classification according to character of business, whether without or with a merger of railway operations and light and power business; and the third, a grouping according to kind of system—"elevated and subway" and "surface." In 1907 statistics were presented for a group of 50 selected interurban lines and 100 selected small urban roads. This classification is of little statistical value and has not been retained.

Classification according to income from railway operations.—Three classes, conforming to the groupings adopted by the Interstate Commerce Commission for electric railways, are distinguished, namely:

Class A.—Companies having income from railway operations of more than $1,000,000.

Class B.—Companies having income from railway operations of more than $250,000 but not in excess of $1,000,000.

Class C.—Companies having income from railway operations not in excess of $250,000.

Classification according to commercial lighting relations.—Two classes are distinguished: Companies without light and power departments and in operation for the full year, designated as class X; and companies covering in single reports the operations of a railway and a light and power department, and in operation for the full year, designated as class Y. There are a few companies whose operations were reported for less than a year, and a few which operated for the purpose of holding franchises, etc., and not primarily for traffic. These as a whole are designated as "Miscellaneous," or "class Z." A combination of the financial statistics for companies engaged in commercial lighting and companies that did not sell current gives unsatisfactory results, and the financial accounts of companies composing the "Miscellaneous" group are not strictly comparable with those of full-time companies operated for traffic.

Classification as "Elevated and subway" and "Surface."—This classification presents the statistics of the companies operating on elevated, subway, or tunnel tracks, in comparison with the data for surface roads or those which are essentially surface.

The elevated and subway group includes only those whose elevated or subway trackage exceeds their surface trackage, and assembles in one class all roads (except the mixed elevated, surface and subway systems of Boston, Mass., and Philadelphia, Pa.) operating on their own exclusive ways, free from the interruptions of street traffic, and in districts of great density. This group comprised in 1907 the four elevated roads of Chicago (Northwestern Elevated, South Side Elevated, Metropolitan West Side Elevated, and Chicago & Oak Park Elevated), and the Interborough Rapid Transit and Brooklyn Union Elevated of New York. These six roads operated 420.40 miles of track, comprising 386.32 miles of elevated and subway tracks and 34.08 miles of surface tracks. The group for 1912 includes seven roads, namely, the four Chicago roads and the Interborough Rapid Transit above named, the New York Consolidated, which includes the Brooklyn Union Elevated of 1907, and the Hudson and Manhattan, which operates tunnels under the Hudson River. These seven companies operate 554.49 miles of track, comprising 437.78 miles of elevated, subway, and tunnel tracks, and 116.71 miles of surface tracks.

Urban and interurban.—There is no sharp line of demarcation between urban and interurban roads. Many roads primarily urban do a large interurban business, and vice versa, and in some cases, although the interurban trackage exceeds the urban trackage, the bulk of the traffic is within the urban territory. The schedule employed for the present census classified the track operated as "city and suburban" or "interurban," but no attempt has been made thus to classify the traffic.

CHAPTER II.

DEVELOPMENT OF THE INDUSTRY.

Table 1 is a summary for the railways of all the classes included at the census of 1912. This table shows the principal facts ascertained at this census, and distinguishes, first, operating companies, and lessor or nonoperating companies; and, second, (*a*) railways operated by electric power, wholly or in part; (*b*) cable roads exclusively including inclined planes; (*c*) railways operated exclusively by gasoline motor power; and (*d*) railways operated exclusively by animal power.

Table 1	Total.	Operating companies.	Lessor electric companies.	OPERATED TRACKAGE, CLASSIFIED BY CHARACTER OF POWER.			
				Electricity (wholly or in part).	Power other than electric, exclusively—		
					Cable.[1]	Gasoline motor.	Animal.[2]
Number of companies	1.260	975	285	943	14	8	10
Miles of line	30,437.86	25,525.52	4,912.34	30,340.36	19.85	61.42	16.23
Miles of track operated	41,064.82	[3] 34,066.26	[4] 6,998.56	40,957.72	25.48	64.55	17.07
Cost of construction and equipment	$4,596,563,292	$3,867,215,202	$729,348,090	$4,596,563,292	$3,023,052	$1,674,595	$90,570
Number of employees	282,461	282,461	....	281,960	414	49	38
Number of passenger cars	76,162	76,162	....	76,016	96	21	29
Number of revenue passengers	9,545,554,667	9,545,554,667	....	9,528,339,013	16,019,850	851,842	343,962

[1] Includes 1 company with both cable and animal power (0.49 of a mile of track operated by animal power).
[2] Includes 1 company with 2 miles of line and 2.03 miles of track operated exclusively by steam power.
[3] Includes track leased from steam railroads, bridge companies, etc.
[4] Track owned by nonoperating electric railway companies.

Electric railways are by far the most important class of roads covered by the census. Of the 943 companies included in this group, three reported the use of animal power, seven cable, and two gasoline motors as the motive power for a portion of the track. The electric railway companies operated 99.7 per cent of the total trackage covered by the census. There were only nine companies that reported the use of animal power exclusively, although this was practically the only kind of power used 30 years ago.

Electric railways and central electric stations.—A comparison of the primary power, dynamo capacity, and output of stations for both central electric stations and electric railways is of interest. It is necessary to make such a combination of the statistics for the two industries because of the constant changes in the extent to which railway companies engage in central station work. A central station reported as such at one census may have been absorbed by some railway company and reported as part of its system at the next enumeration. Table 2 presents the combined totals for the two industries, with reference to primary power, dynamo capacity, and output of stations, by geographic divisions, for 1912 and 1907.

There has been a large increase in primary power during the last five years. The total horsepower increased from 6,618,011 in 1907 to 11,193,699 in 1912, or 69.1 per cent. Steam power still largely predominates, although the increase in water power has been much greater than that for any other class. There was a decrease of 1,314 in the number of steam engines and steam turbines, while this class of power increased 3,011,286 horsepower, or 59 per cent, the increase in horsepower per unit being from 447 in 1907 to 803 in 1912.

The utilization of water power has resulted in the completion of many large hydroelectric plants in all sections where it is available and within transmitting distance. This class of power increased from 1,441,048 horsepower in 1907 to 2,942,388 in 1912, or 104.2 per cent, the increase per unit being from 532 to 887. The greatest development of water power has been in the Pacific division, although that in the Middle Atlantic division has been very marked. The increase in horsepower of gas and oil engines was 87.4 per cent for the five years.

The increase in generating capacity has been greater than that in primary power, the kilowatt capacity of dynamos having increased from 4,432,641 in 1907 to 7,642,755 in 1912, or 72.4 per cent, as compared with an increase of 69.1 per cent in primary power. This increase is wholly in alternating-current generators, direct-current dynamos showing a decrease in all geographic divisions with the exception of the East South Central. There were 17,585,662,014 kilowatt hours generated during the year, an increase of 6,964,255,177 kilowatt hours, or 65.6 per cent, over the figure for 1907.

COMPARATIVE SUMMARY—ELECTRIC RAILWAYS AND CENTRAL ELECTRIC STATIONS COMBINED—PRIMARY POWER, DYNAMO CAPACITY, AND OUTPUT OF STATIONS, BY GEOGRAPHIC DIVISIONS: 1912 AND 1907.

Table 2

DIVISION.[1]	Census.	PRIMARY POWER.							KILOWATT CAPACITY OF DYNAMOS.			Total output of stations, kilowatt hours.
		Total horse-power.	Steam engines and steam turbines.		Gas and oil engines.		Water wheels.		Total.	Direct current.	Alternating current.	
			Number.	Horse-power.	Number.	Horse-power.	Number.	Horse-power.				
United States	1912	11,193,699	10,108	8,116,086	1,164	135,225	3,316	2,942,388	7,642.755	1,243,365	6,399,390	17,585,662,014
	1907	6,618,011	11,422	5,104,800	504	72,163	2,709	1,441,048	4,432,641	1,428,954	3,003,687	10,621,406,837
New England	1912	1,157,132	885	903,604	55	10,017	563	243,511	820,628	210,017	610,611	1,555,814,478
	1907	718,499	1,126	566,829	39	6,823	520	144,847	501,427	240,673	260,754	1,015,385,019
Middle Atlantic	1912	2,991,020	1,961	2,291,573	192	33,939	595	665 508	2,047,134	340,876	1,706,258	5,371,253,169
	1907	1,927,114	2,478	1,561,260	118	17,137	532	348,717	1,338,048	449,593	888,455	3.679.460.449
East North Central	1912	2,515,706	2,627	2,183,091	224	26,710	703	305,905	1,756,368	342,488	1,413,880	3,995,158,144
	1907	1,473,949	3,137	1,318,501	123	12,725	610	142,723	976,419	371,929	604,490	2,343,163,832
West North Central	1912	929,220	1,513	766,922	424	29,578	272	132,720	641,343	113,222	528,121	1,209,359,546
	1907	577,054	1,538	468,027	97	7,336	200	101,691	379,206	113,895	265,311	786,641,429
South Atlantic	1912	1,004,038	945	587,888	60	11,373	385	404,777	682,325	79,616	602,709	1,074,027.912
	1907	552,496	950	374,427	31	6,520	266	171,549	367,195	89,764	277,431	643,771,881
East South Central	1912	354,338	616	315,628	13	1,080	47	37,630	241,347	48,286	193,061	476,150,487
	1907	218,799	603	210,492	3	60	29	8,247	147,736	43,924	103,812	298,426,946
West South Central	1912	344,799	890	318,767	153	17,354	35	8,678	242,617	48,608	194,009	425,302,675
	1907	206,039	813	199,287	59	3,690	24	3,062	136,856	51,604	85,252	258,425,302
Mountain	1912	518,721	306	179,637	20	2,695	313	336,389	317,176	17,089	300,087	980,641,612
	1907	261,597	337	112,244	13	855	231	148,498	175,220	22,677	152,543	446,471,639
Pacific	1912	1,378,725	365	568,976	23	2,479	403	807,270	893,817	43,163	850,654	2,497,953,991
	1907	682,464	440	293,733	21	17,017	297	371,714	410,534	44,895	365,639	1,149,660,340

[1] See page 25 (Central Electric Light and Power Stations) for states composing the several geographic divisions.

In addition to power employed for electric generation by the electric railways and the central electric stations, 193,956 horsepower was utilized in electric generation by traction companies not included in the street and electric railway industry, namely, those operating the electrified divisions of steam roads, the electrified tunnels of steam roads, and the two freight tunnels already referred to. Table 3 gives the combined power statistics for electric traction systems and central electric stations in 1912.

Table 3

	POWER STATISTICS FOR ALL ELECTRIC TRACTION SYSTEMS AND CENTRAL ELECTRIC STATIONS: 1912.			
	Total.	Electric railways.	Electrified divisions of steam roads, electrified tunnels, etc.	Central electric stations.
Total horsepower	11,387,655	3,665,051	193,956	7,528,648
Steam engines and steam turbines:				
Number	10,175	2,264	67	7,844
Horsepower	8,302,042	3,169,554	185,956	4,946,532
Gas and oil engines:				
Number	1,164	48	....	1,116
Horsepower	135,225	24,190	....	111,035
Water wheels and turbines:				
Number	3,319	383	3	2,933
Horsepower	2,950,388	471,307	8,000	2,471,081
Kilowatt capacity of dynamos	7,800,591	2,508,066	157,836	5,134,689
Direct current	1,254,205	769,875	10,840	473,490
Alternating current	6,546,386	1,738,191	146,996	4,661,199
Total output of stations, kilowatt hours	17,872,783,119	6,052,699,008	287,121,105	11,532,963,006

Comparison with prior censuses.—The censuses of 1890 and 1902 covered the 12 months ending with June 30 of the respective years, while those for 1907 and 1912 related to the calendar years. Since 1890 the scope of the inquiry has been broadened to meet the changes incident to the more general use of electricity as a motive power, and the interests represented by the statistics for 1912 differ in many important respects from those covered by the figures for the earlier censuses. In 1890 practically all railways, except those operated by steam, were correctly designated "street railways," as they were confined mainly to urban districts and operated on public streets. Now, however, many of the roads included in the class of "street and electric railways" extend into rural districts and engage in business similar to that of steam railroads.

Substantially the same form of schedule was used at the censuses of 1902, 1907, and 1912. In formulating the schedule for 1912, however, it was deemed advisable to omit some of the subinquiries used at prior censuses because the statistics secured from these inquiries were not entirely satisfactory. The most important change affecting the comparability of the statistics relates to the number of persons employed. For the censuses of 1902 and 1907 the average number employed during the entire year was reported; the schedule of 1912 called for the number employed on September 16, and if statistics were not available for that day or month, data were obtained for the nearest representative or normal day. For the majority of establishments it was impossible to obtain a correct average of the number employed during the entire year, and it was believed that obtaining the number on a specified day would result in greater uniformity, also that this number would not vary greatly from the average number if the average was correctly computed. In many instances it is difficult to classify the employees according to the work upon which they are engaged, and in preparing the schedule for the census of 1912 it was decided to attempt only three groupings of wage earners, namely, conductors, motormen, and all other wage earners.

In 1890 only 706 out of the 789 street railways in the country made reports to the Census Bureau. The figures of trackage, cost of construction, number of cars, number of employees, and number of passengers for the remaining 83 companies were either obtained from outside sources or estimated. The data thus secured from sources other than certified returns constituted from 4.2 to 10.4 per cent of the totals for the respective items mentioned. The returns of earnings and expenditures and of car-mileage were incomplete, even in the case of many of the companies which reported fully other statistics; but these returns were not supplemented by estimates, so that the figures given as totals represent from 10 to 20 per cent less than the actual totals for all companies.

Of the operating and lessor companies covered by the census of 1902, only 20 failed to report the cost of construction; and of the operating companies, only 20 failed to furnish statistics of employees, 6 of fare passengers, and 18 of earnings and expenses. Moreover, two of the six companies that did not report the number of fare passengers were exclusively freight companies.

The statistics for 1907 represent operating companies, whether they were in operation during the whole year or only a portion of the year. Six operating companies, however, failed to report financial data.

The statistics for 1912 are essentially complete and based upon certified returns. In only a few cases has it been necessary to resort to the reports of public-service commissions, railroad commissions, or other similar sources for data.

Table 4 is a comparative summary, and shows the principal features covered by the census of street and electric railways that are comparable for 1912, 1907, 1902, and 1890, together with the percentages of increase.

STREET AND ELECTRIC RAILWAYS—COMPARATIVE SUMMARY.

Table 4	1912	1907	1902	1890	PER CENT OF INCREASE.[1]			
					1902-1912	1907-1912	1902-1907	1890-1902
Number of companies	1,260	1,236	987	789	27.7	1.9	25.2	25.1
Operating	975	945	817	769	19.3	3.2	15.7	6.2
Lessor	285	291	170	20	67.6	−2.1	71.2	750.0
Miles of line	[2] 30,437.86	25,547.19	16,645.34	5,783.47	82.9	19.1	53.5	187.8
Miles of track	[3] 41,064.82	[4] 34,381.51	[5] 22,576.99	8,123.02	81.9	19.4	52.3	177.9
Operated by—								
Electricity	40,808.39	34,037.64	21,901.53	1,261.97	86.3	19.9	55.4	1,635.5
Cable	56.41	61.71	240.69	488.31	−76.6	−8.6	−74.4	−50.7
Animal power	57.52	136.11	259.10	5,661.44	−77.8	−57.7	−47.5	−95.4
Steam	76.34	105.06	169.61	711.30	−55.0	−27.3	−38.1	−76.2
Gasoline motor	66.16	40.99	[6] 6.06	....	991.7	61.4	....	....
Cost of construction and equipment	$4,596,563,292	$3,637,668,708	$2,167,634,077	$389,357,289	112.1	26.4	67.8	456.7
Number of employees	282,461	221,429	140,769	70,764	100.7	27.6	57.3	98.9
Number of passenger cars	76,162	70,016	60,290	32,505	26.3	8.8	16.1	85.5
Number of revenue passengers	9,545,554,667	7,441,114,508	4,774,211,904	2,023,010,202	99.9	28.3	55.9	136.0
Number of revenue passengers per mile of track	[7] 232,556	[8] 216,522	[9] 212,217	249,047	9.6	7.4	2.0	−14.8
Ratio of operating expenses to operating revenues (per cent)	58.7	60.1	57.5	68.4	....	....	....	....

[1] A minus sign (−) denotes decrease.
[2] Exclusive of 19.73 miles not operated and 18.26 miles leased to steam railroad companies.
[3] Exclusive of 23.49 miles not operated and 31.22 miles leased to steam railroad companies.
[4] Exclusive of 17.05 miles not operated and 5 miles leased to steam railroad companies.
[5] Exclusive of 17.60 miles of duplicated track but including 4.47 miles not operated.
[6] Compressed air.
[7] Exclusive of trackage of two railways carrying freight only and of track not operated by electric railway companies.
[8] Exclusive of trackage of one railway carrying freight only and of track not operated by electric railway companies.
[9] Exclusive of trackage of two railways carrying freight only and of four companies not reporting revenue passengers.

The total trackage shown in the tables throughout this report represents the mileage owned or leased by companies in continental United States. In some cases the track extends across the border into Canada and Mexico. This trackage outside of the United States amounted to 31.91 miles in 1912, 27.52 miles in 1907, and 4.20 miles in 1902.

The total trackage reported as owned by the railway companies at the census of 1912 was 40,470.13 miles, this including 23.49 miles of idle track and 31.22 miles of track leased to steam railroads.

The railway companies operated 415.77 miles of track leased from steam roads and operated over 233.63 miles of trackage rights from steam roads. Deducting from the track owned that which was idle or leased to steam roads, and adding thereto the track leased from steam roads and the trackage rights from steam roads, there is obtained the total trackage operated by the street and electric railways, namely, 41,064.82 miles.

The total trackage owned is comparable with 34,403.56 miles in 1907, an increase for the five-year period of 6,066.57 miles, or 17.6 per cent. The increase during the same period in track operated was 6,683.31 miles, or 19.4 per cent. The electrification of the street railways was essentially completed by 1902, the trackage operated by power other than electric in that year constituting but 3 per cent of the total trackage. In 1907 the trackage other than electric constituted 1 per cent of the total and in 1912 six-tenths of 1 per cent. The percentages of increase show a large growth during each five-year period.

The cost of construction and equipment as reported by a large number of companies is practically the par value of their outstanding stock and bonds, but there are many exceptions to this rule, due to a considerable extent to the investment of surplus earnings in plant and equipment without a corresponding increase in capitalization. The amount reported for cost of construction and equipment should not be taken as representing the actual amount invested in tracks, railway equipment, and railway property. It includes investments in installations for the generation of electric power not all of which is used for railway purposes, and in distributing installations of light and power departments of electric railways; some investments in other industries, office buildings, etc., not separable from railway investments; and a large amount of intangible capital, capitalized franchise values, etc. At the census of 1907 nearly one-half (48.3 per cent) of the companies furnishing balance sheets stated that franchise values were included under cost of construction, and one-third (32.9 per cent) that they were not included, the remainder failing to answer the inquiry. The totals for 1912, 1907, and 1902 are more nearly comparable with each other than either is with 1890, because of greater uniformity in the practice of railway accountants in the later years in regard to the items which should be charged to cost of construction. The cost of construction and equipment as reported shows an average of $113,579 per mile of track owned in 1912, as compared with $105,735 per mile of track in 1907 and $96,005 in 1902. For 1890, when horse cars prevailed, the average investment per mile of track was $47,933.

The number of revenue passengers carried per mile of track indicates a steady increase in density of traffic during the last decade, namely, from 212,259 in 1902 to 216,522 in 1907 and 232,556 in 1912. During the prior census period 1890 to 1902 there was a decrease in traffic density, due to the great expansion of electric lines, the trackage increase being relatively greater than the growth in passenger traffic.

At the censuses of 1912, 1907, and 1902 substantially the same form of schedule was used, so that a comparison more in detail can be made for these years. Such a comparison is given in Table 5.

This table shows remarkable gains for all branches of the industry. The track operated during 1912 exceeded that in 1902 by 18,492.30 miles, the percentage of increase being 81.9. The horsepower of the prime movers required to generate the electric motive power increased almost threefold. The number of passengers carried during 1912 was more than twice as great as the corresponding number for 1902. There were 1,260 companies reported in 1912, an increase of 24, or 1.9 per cent, since 1907, of which 975 were operating and 285 lessor. Operating companies showed an increase of 3.2 per cent during the last five-year period, while there was a decrease of 2.1 per cent in the number of lessor companies.

No effort was made to secure data for railway properties under construction in 1912 unless actually in operation during a portion of the year. Limited data of this character were secured for the census of 1907, but owing to the difficulty in obtaining actual figures for the amounts invested in partially expired contracts for construction, equipment, etc., it was decided to abandon the inquiry.

In considering the large increase in the number of salaried employees and in total salaries paid, cognizance must be taken of the differences between the schedules used at the two censuses. In 1907 among the enumerated classes of wage earners were foremen, inspectors, and electricians, and it appears probable that some companies included certain classes of employees that had been reported as wage earners in 1907, as salaried employees in 1912.

The relatively large increase in cars, other than passenger cars, is due to the development of freight business on interurban lines.

Figures are not available for the quantity of current purchased in 1907 and 1902, but the expenditure for power purchased was $24,546,530 in 1912, as compared with $12,342,258 in 1907 and $3,871,518 in 1902. The aggregate of current generated and current purchased involves duplication, as it includes power purchased from railway companies as well as that purchased from electric power companies. It is not practicable to determine the extent of this duplication, though it may be stated that the greater part of the current purchased is generated by electric power companies. The value of current purchased from electric railway companies also causes duplication in the financial data, appearing as income in the reports of the railway companies generating the current, and as expense in the reports of the companies to which it was sold. Nor can any comparison be made between quantity of current generated and purchased and car mileage, as considerable current is sold by the railway companies for light and industrial purposes. The revenue received from the sale of current for light and power, including sale of current to other public-service corporations, was $36,500,030 in 1912, $20,093,302 in 1907, and $7,703,574 in 1902. The percentages of increase for this class of revenue, namely, 373.8 per cent, 81.7 per cent, and 160.8 per cent for the census periods 1902–1912, 1907–1912, and 1902–1907, respectively, are about threefold those for transportation revenues, the percentages of increase for the latter being, respectively, 120.4, 33.3, and 65.4.

COMPARATIVE SUMMARY, INCLUDING TRAFFIC, INCOME, AND CAPITALIZATION: 1912, 1907, AND 1902.

Table 5	1912	1907	1902	PER CENT OF INCREASE.[1]		
				1902-1912	1907-1912	1902-1907
Number of companies	1,260	1,236	987	27.7	1.9	25.2
Operating	975	945	817	19.3	3.2	15.7
Lessor	285	291	170	67.6	−2.1	71.2
Miles of line	30,437.86	25,547.19	16,645.34	82.9	19.1	53.5
Miles of single track[2]	41,064.82	34,381.51	22,572.52	81.9	19.4	52.3
Rolling stock:						
Cars, number	94,016	83,641	66,784	40.8	12.4	25.2
Passenger	76,162	70,016	60,290	26.3	8.8	16.1
All other	17,854	13,625	6,494	174.9	31.0	109.8
Electric locomotives	277	117	3	....	....	....
Persons employed by operating companies:						
Number	282,461	[3] 221,429	[3] 140,769	100.7	27.6	57.3
Salaries and wages	$200,890,939	$150,991,099	$88,210,165	127.7	33.0	71.2
Salaried employees—						
Number	23,271	11,700	7,128	226.5	98.9	64.1
Salaries	$26,128,786	$12,909,466	$7,439,716	251.2	102.4	73.5
Wage earners—						
Average number	[4] 259,190	209,729	133,641	93.9	23.6	56.9
Wages	$174,762,153	$138,081,633	$80,770,449	116.4	26.6	71.0
Power:						
Horsepower, total	3,665,051	2,519,823	1,359,285	169.6	45.4	85.4
Steam (including turbines) and gas engines—						
Number	2,312	3,409	2,652	−12.8	−32.2	28.5
Horsepower	3,193,744	2,427,862	1,310,132	143.8	31.5	85.3
Water wheels—						
Number	383	228	159	140.9	68.0	43.4
Horsepower	471,307	91,961	49,153	858.9	412.5	87.1
Kilowatt capacity of dynamos	2,508,066	1,723,416	898,362	179.2	45.5	91.8
Output of stations, kilowatt hours	6,052,699,008	4,759,130,100	2,261,484,397	167.6	27.2	110.4
Current purchased, kilowatt hours	2,967,318,781	(5)	(5)	....	....	....
Traffic:						
Passengers carried	12,135,341,716	9,533,080,766	5,836,615,296	107.9	27.3	63.3
Revenue	9,545.554,667	7,441,114,508	4,774,211,904	99.9	28.3	55.9
Transfer	2,423,918,024	1,995,658,101	1,062,403,392	128.2	21.5	87.8
Free	165,869,025	96,308,157	(5)	....	72.2	....
Revenue car mileage	1,921,620,074	1,617,731,300	1,144,430,466	67.9	18.8	41.4
Passenger	1,885,870.157	1,583,831,199	1,120,101,944	68.4	19.1	41.4
Express, mail, and freight	35,749,917	33,900,101	24,328,522	46.9	5.5	39.3
Revenue car hours[6]	190,478,140	151,338,944	65,869,342	....	....	....
Passenger	187,590.223	148,678,052	65,403,287	....	....	....
Express, mail, and freight	2,887,917	2,660,892	466,055	....	....	....
Average number of revenue passengers—						
Per mile of track operated[7]	232,556	216,522	212,217	9.6	7.4	2.0
Per revenue passenger car mile	5.06	4.70	4.26	....	....	....
Per revenue passenger car hour	48.38	43.06	33.28	....	....	....
Condensed income accounts:						
Operating companies—						
Gross income[8]	$585,930,517	$429,744,254	$250,504,627	133.9	36.3	71.6
Operating revenues	567,511,704	418,187,858	247,553,999	129.2	35.7	68.9
Transportation revenues	520,184,773	390,276,347	235,997,005	120.4	33.3	65.4
Nontransportation revenues	47,326,931	27,911,511	11,556,994	309.5	69.6	141.5
Income from other sources	18,418,813	11,556,396	2,950,628	524.2	59.4	291.7
Operating expenses	332,896,356	251,309,252	142,312,597	133.9	32.5	76.6
Net earnings (operating revenues less operating expenses)	234,615,348	166,878,606	105,241,402	122.9	40.6	58.6
Gross income, less operating expenses	253,034,161	178,435,002	108,192,030	133.9	41.8	64.9
Deductions from income	191,123,408	138,094,716	77,595,053	146.3	38.4	78.0
Taxes	35,027,965	19,755,602	13,078,899	167.8	77.3	51.0
Interest on funded and floating debt and mortgages	98,025,338	63,740,744	38,085,911	157.4	53.8	67.4
Rent of leased lines and terminals	44,784,521	48,022,596	25,518,225	75.5	−6.7	88.2
Miscellaneous	13,285,584	6,575,774	912,018	....	....	....
Net income	61,910,753	40,340,286	30,596,977	102.3	53.5	31.8
Dividends	51,650,117	26,454,732	15,882,110	225.2	95.2	66.6
Surplus	10,260,636	13,885,554	14,714,867	−30.3	−26.1	5.6
Lessor companies—						
Gross income[9]	35,605,367	47,913,249	26,138,899	36.2	−25.7	83.3
Rentals from operating companies	35,144,521	47,500,933	26,116,884	34.6	−26.0	81.9
Miscellaneous income	460,846	412,316	22,015	....	11.8	....
Deductions from income	16,090,372	19,465,984	8,779,294	83.3	−17.3	121.7
Interest on funded and other debt	15,234,132	18,030,522	8,376,559	81.9	−15.5	115.2
Miscellaneous deductions	856,240	1,435,462	402,735	112.6	−40.4	256.4
Net income	19,514,995	28,447,265	17,359,605	12.4	−31.4	63.9
Dividends	19,342,101	28,030,542	17,157,061	12.7	−31.0	63.4
Surplus	172,894	416,723	202,544	−14.6	−58.5	105.7
Capitalization:						
Total	4,708,568,141	3,774,772,096	2,308,282,099	104.0	24.7	63.5
Operating companies	3,956,718,023	2,811,876,374	1,775,468,781	122.9	40.7	58.4
Lessor companies	751,850,118	962.895,722	532,813,318	41.1	−21.9	80.7
Capital stock	2,379,346,313	2,097.708,856	1,315,572,960	80.9	13.4	59.5
Operating companies	1,957,300,149	1,543,269,002	982,969,070	99.1	26.8	57.0
Lessor companies	422,046,164	554,439,854	332,603,890	26.8	−23.9	66.7
Funded debt	2,329,221,828	1,677,063.240	992,709,139	134.6	38.9	68.9
Operating companies	1,999,417,874	1,268,607,372	792,499,711	152.3	57.6	60.1
Lessor companies	329,803,954	408,455,868	200,209,428	64.7	−19.3	104.0

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[1] A minus sign (−) denotes decrease.

[2] Includes track lying outside the United States, namely, 1912, 31.91 miles; 1907, 27.52 miles; and 1902, 4.20 miles. Exclusive of track not operated.

[3] For 939 companies in 1907 and for 797 companies in 1902.

[4] Number employed Sept. 16, 1912.

[5] Figures not available.

[6] Represents 899 companies in 1912, 734 companies in 1907, and 390 companies in 1902.

[7] Exclusive of companies doing freight traffic only and in 1902 of 4 companies not reporting revenue passengers.

[8] Exclusive of 6 companies in 1907 and of 18 companies in 1902 which failed to furnish this information.

[9] Exclusive of 12 companies in 1902 which failed to furnish this information.

Although the number of lessor companies in 1912 is but six less than the number reported in 1907, notable decreases are shown in the income, dividends, and capitalization of such companies.

The income of the lessor companies on account of rentals from the operating companies was $35,144,521 in 1912, as compared with $47,500,933 in 1907, a decrease of 26 per cent; and the capitalization of the companies leasing their properties was $751,850,118 in 1912, as compared with $962,895,722 in 1907, a decrease of 21.9 per cent. The changes that occurred during the decade are brought out more clearly by the percentages given in Table 6.

Table 6

	PER CENT DISTRIBUTION OF ITEMS IN TABLE 5.		
	1912	1907	1902
Number of companies	100.0	100.0	100.0
Operating	77.4	76.5	82.8
Lessor	22.6	23.5	17.2
Cars, total number	100.0	100.0	100.0
Passenger	81.0	83.7	90.3
All other	19.0	16.3	9.7
Persons employed, total number	100.0	100.0	100.0
Salaried employees	8.2	5.3	5.1
Wage earners	91.8	94.7	94.9
Power, total horsepower	100.0	100.0	100.0
Steam and gas engines	87.1	96.3	96.4
Water wheels	12.9	3.7	3.6
Traffic:			
Passengers carried, total number	100.0	100.0	100.0
Revenue	78.6	78.1	81.8
Transfer	20.0	20.9	18.2
Free	1.4	1.0	....
Per cent of revenue passengers[1]—			
Revenue passengers	100.0	100.0	100.0
Transfer	25.4	26.8	22.3
Free	1.7	1.3	....
Revenue car-mileage	100.0	100.0	100.0
Passenger	98.2	97.9	97.9
Express, mail, and freight	1.8	2.1	2.1
Revenue car-hours	100.0	100.0	100.0
Passenger	98.5	98.2	99.3
Express, mail, and freight	1.5	1.8	0.7
Income accounts:			
Operating companies—			
Gross income	100.0	100.0	100.0
Operating revenues	96.8	97.3	98.8
Transportation revenues	88.7	90.8	94.2
Nontransportation revenues	8.1	6.5	4.6
Income from other sources	3.2	2.7	1.2
Operating expenses	56.8	58.5	56.8
Net earnings (operating revenues less operating expenses)	40.0	38.8	42.0
Gross income less operating expenses	43.2	41.5	43.2
Deductions from income	32.6	32.1	31.0
Net income	10.6	9.4	12.2
Dividends	8.8	6.2	6.3
Surplus	1.8	3.2	5.9
Lessor companies—			
Gross income	100.0	100.0	100.0
Rentals from operating companies	98.7	99.1	99.9
Miscellaneous income	1.3	0.9	0.1
Deductions from income	45.2	40.6	33.6
Interest	42.8	37.6	32.1
Miscellaneous	2.4	3.0	1.5
Net income	54.8	59.4	66.4
Dividends	54.3	58.5	65.6
Surplus	0.5	0.9	0.8
Capitalization	100.0	100.0	100.0
Operating companies	84.0	74.5	76.9
Lessor companies	16.0	25.5	23.1
Capital stock	50.5	55.6	57.0
Operating companies	41.5	40.9	42.6
Lessor companies	9.0	14.7	14.4
Funded debt	49.5	44.4	43.1
Operating companies	42.5	33.6	34.4
Lessor companies	7.0	10.8	8.7
Dividends	100.0	100.0	100.0
Operating companies	72.8	48.6	48.1
Lessor companies	27.2	51.4	51.9
Interest on funded debt, floating debt, and mortgages	100.0	100.0	100.0
Operating companies	86.5	78.0	82.0
Lessor companies	13.5	22.0	18.0

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[1] Ratio of transfer and free passengers to revenue passengers.

This table brings out a number of important changes which took place in the equipment, traffic, income, and expenses of the street and electric railways between 1902 and 1912. Cars, other than passenger cars, form an increasing proportion of the total number at each census, and water power shows a marked relative increase as compared with steam and gas power. Slight gains are also shown in the numbers of revenue and free passengers carried. As previously explained, the increase in the proportion of salaried employees as compared with wage earners is due probably to differences between the constructions placed upon the inquiry at the last two censuses.

There appears under "Income" a relatively large and steady gain in nontransportation and nonoperating income. In this connection a comparison of income and expense on a passenger basis is of interest. Table 7 shows the gross income, the several classes of income, and the distribution accounts, reduced to a unit revenue-passenger basis, for 1912, 1907, and 1902.

Table 7

ACCOUNT.	INCOME AND EXPENSE PER REVENUE PASSENGER.		
	1912	1907	1902
	Cents.	*Cents.*	*Cents.*
Gross income	6.14	5.78	5.25
Transportation revenue	5.45	5.25	4.95
Passenger revenue	5.27	5.14	4.90
Other transportation revenue	0.18	0.11	0.05
Nontransportation income	0.69	0.53	0.30
Operating expenses	3.49	3.38	2.98
Gross income less operating expenses	2.65	2.40	2.27
Deductions from income	2.00	1.86	1.63
Net income	0.65	0.54	0.64

Increase in size of companies.—There is no uniformity in the size or importance of the properties operated by the separate companies, and frequently, because of certain legal restrictions, several properties that practically form one system have been reported as distinct units and counted as separate companies, while, on the other hand, where legal restrictions have not prohibited similar groups of properties have been reported in combination and counted as one. The combination of formerly independent companies has characterized the development of electric railways during recent years, and the change in the number of companies reported at the different censuses is no indication of the increase or decrease in the extent of the industry. Table 8 shows the average size and traffic of the operating companies in 1912, 1907, 1902, and 1890, in miles of track, number of cars, passenger-car-miles, revenue passengers, and number of employees.

In 1912 the average company operated approximately four times as much track and almost twice as many cars as in 1890, while the average number of revenue passengers per car carried in 1912 was 125,332, as compared with 62,237 in 1890. This shows an increase in the average number per car of a little more than 100 per cent for the period. The mileage of passenger cars was not reported prior to 1902. The average number of passenger-car-miles per company increased from 1,370,994 in 1907 to 1,938,202 in 1912, or 41.4 per cent, and during the same period the miles of track per company increased from 27.63 to 42.12, or 52.4 per cent.

Table 8	COMPARATIVE SIZE OF OPERATING COMPANIES[1] AS INDICATED BY AVERAGE NUMBER OF—				
	Miles of track.	Passenger cars.	Passenger-car-miles.	Revenue passengers.	Number of employees.
Census:					
1912	42.12	78	1,938,202	9,810,436	290
1907	36.38	74	1,677,787	7,882,537	236
1902	27.63	74	1,382,842	5,886,821	177
1890	10.56	42	(2)	2,630,702	92
Per cent of increase:					
1902–1912	52.4	5.4	40.2	66.7	63.8
1907–1912	15.7	5.4	15.6	24.5	22.9
1902–1907	31.8	....	21.3	33.9	33.3
1890–1902	161.6	76.2	....	123.8	92.4

[1] In 1912, 2 companies, and in 1907, 1 company, had no revenue passengers (freight only).
[2] Figures not available.

The increase in the size of companies is further illustrated by the classification of the companies according to miles of line for the several census years, given in Table 9. The term "miles of line" refers to the length of the first main track or road, and does not cover second tracks, sidings, or turnouts.

Table 9	COMPANIES CLASSIFIED ACCORDING TO MILES OF LINE.				
	Total.	Classification groups—miles of line per company.			
		Less than 10.	10 and less than 50.	50 and less than 100.	100 and over.
Number of operating companies:					
1912	975	406	421	89	59
1907	945	399	424	75	47
1902	817	394	354	44	25
1890	[1] 691	557	126	6	2
Per cent of total—					
1912	100.0	41.6	43.2	9.1	6.1
1907	100.0	42.2	44.9	7.9	5.0
1902	100.0	48.2	43.3	5.4	3.1
1890	100.0	80.6	18.2	0.9	0.3
Miles of line:					
1912	30,437.86	1,992.51	9,337.41	5,985.93	13,122.01
1907	25,547.19	2,012.37	9,337.33	5,135.33	9,062.16
1902	16,645.34	1,957.16	7,340.65	2,998.43	4,349.10
1890	[2] 5,119.53	2,304.49	2,183.59	392.80	238.65
Per cent of total—					
1912	100.0	6.5	30.7	19.7	43.1
1907	100.0	7.9	36.5	20.1	35.5
1902	100.0	11.8	44.1	18.0	26.1
1890	100.0	45.0	42.7	7.7	4.7

[1] Exclusive of 78 companies that did not make precise returns of trackage.
[2] Exclusive of 663.94 miles, estimated.

The lower group, "Less than 10" miles of line, included the largest amount of line and four-fifths of the companies in 1890, and the higher group, "100 and over," the largest amount of line in 1912, the "10 and less than 50" group having the largest number of companies. The increase in miles of line from 1907 to 1912 is found in the two larger groups, the lower group decreasing 19.86 miles and the "10 and less than 50" group being essentially the same in 1912 and 1907. In 1912 there was no company in Connecticut, Rhode Island, or Utah with less than 10 miles of line; no company in South Dakota, New Mexico, or Nevada with more than 10 miles; no company in Vermont, North Dakota, Delaware, District of Columbia, North Carolina, Florida, Mississippi, Arkansas, Montana, Arizona, or Wyoming with more than 50 miles; and no company in New Hampshire, Nebraska, Kansas, West Virginia, South Carolina, Kentucky, Tennessee, Alabama, Louisiana, Oklahoma, Texas, Idaho, or Utah with more than 100 miles of line.

The average length of line per company in 1890 was 7.4 miles; in 1902, 20.4 miles; in 1907, 27 miles; and in 1912, 31.2 miles, or more than four times the average in 1890. At the last census there were 59 companies that reported more than 100 miles of line, as compared with 47 in 1907, 25 in 1902, and 2 in 1890. The average length of line for these companies increased from 119.3 miles in 1890 to 174 miles in 1902, 192.8 miles in 1907, and 222.4 miles in 1912.

The 59 companies that operated over 100 miles of line during 1912 include a number that operated more than 500 miles of track. The following statement shows the miles of line and track for the 10 systems reporting the greatest mileages for 1912, ranked according to length of line:

	MILES OF—	
	Line.	Track.
Bay State Street Railway, Massachusetts	754.73	941.79
Ohio Electric Railway Co., Ohio	601.00	669.10
The Connecticut Co., Connecticut	592.80	803.09
Pacific Electric Co., California	552.48	970.80
Public Service Railway Co., New Jersey	484.90	809.50
Philadelphia Rapid Transit Co., Pennsylvania	436.62	649.72
New York State Railways	337.05	576.95
Pittsburg Railways Co., Pennsylvania	334.58	594.30
Chicago Railways Co., Illinois	244.00	515.00
Boston Elevated Railway Co., Massachusetts	237.78	500.52

Increase in trackage and motive power.—Between 1890 and 1907 the miles of track of street and electric railways increased 26,280.54 miles. During the last five years of this period the increase was 11,826.57 miles, an annual average of 2,365.31 miles. The increase from 1907 to 1912 was 6,715.97 miles, the annual average being 1,343.19 miles. The annual increase computed from a comparison of trackage by years indicates that the greatest development occurred during the year 1906.[1]

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[1] The following statement compiled by the Electric Railway Journal shows the total miles of track for each year from 1890 to 1912. The figures for 1890, 1902, and 1907 are not comparable with those obtained by the censuses for those years because there were fewer restrictions in regard to the class of companies included in the statistics presented in the Journal than in the case of those covered by the census. The table, however, shows the years in which the greatest development occurred.

YEAR.	Miles of track.	YEAR.	Miles of track.
1912	43,043	1900	20,442
1911	41,028	1899	18,942
1910	[1] 40,088	1898	17,549
1909	40,490	1897	15,718
1908	40,247	1896	15,094
1907	38,812	1895	14,470
1906	36,932	1894	13,588
1905	32,517	1893	12,187
1904	29,548	1892	11,634
1903	27,920	1891	10,599
1902	26,292	1890	8,123
1901	23,184		

[1] Apparent decrease probably due to some discrepancy in the returns.

Table 4 shows that from 1890 to 1912 the miles of line increased 24,692.38. During each of the periods between the first three censuses the percentage of increase for miles of line was greater than for miles of track, by reason of the fact that a large proportion of the extensions consisted of single-track roads in small towns and rural districts. Since 1907, however, the miles of track have increased slightly more than the miles of line.

The increase in trackage and line has been almost entirely for lines employing electricity as motive power. Except in the case of lines operated by gasoline motor power, which are of but little importance, there has been a rapid decrease in the trackage operated by all other kinds of power. Table 10 shows the number of miles of track operated by each of the several kinds of power, for 1912, 1907, 1902 and 1890.

Table 10 CHARACTER OF POWER.	MILES OF TRACK, BY CHARACTER OF POWER.			
	1912	1907	1902	1890
Total	41,064.82	34,381.51	22,576.99	8,123.02
Electric	40,808.39	34,037.64	21,901.53	1,261.97
Cable	56.41	61.71	240.69	488.31
Animal	57.52	136.11	259.10	5,661.44
Steam	76.34	105.06	169.61	711.30
Gasoline motors	66.16	40.99	[1] 6.06	....
Per cent of total:				
Electric	99.4	99.0	97.0	15.5
Cable	0.1	0.2	1.1	6.0
Animal	0.1	0.4	1.1	69.7
Steam	0.2	0.3	0.8	8.8
Gasoline motors	0.2	0.1	(2)	....

[1] Compressed air.

[2] Less than one-tenth of 1 per cent.

The table shows conclusively that since 1890 electricity has practically superseded all other kinds of power. The percentage of trackage operated by electric current increased from 15.5 in 1890 to 99.4 in 1912. Animal power was the most important form of power in 1890 (69.7 per cent), while in 1912 it had decreased to one-tenth of 1 per cent. In 1912 gasoline motor cars were operated on 66.16 miles of track, the increase in such mileage having been 61.4 per cent since 1907.

Cable and steam power were never extensively used in the operation of street railways, but they reached their maximum about 1890. The 56.41 miles of cable track reported for 1912 includes 11.70 miles of track reported by 15 companies operating inclined planes, and 44.71 miles of street cable tracks operated by 6 companies. In 1907, 12 companies operated 8.96 miles of inclined-plane cable tracks, and 8 companies 52.75 miles of street cable tracks. Thus during the period 1907-1912 there was an increase in inclined-plane cable trackage of 2.74 miles, and a decrease in street cable trackage of 8.04 miles. The trackage of the Geary Street, Park & Ocean Railroad Co., of San Francisco, which operated 6.93 miles of street cable, is included in the foregoing. Operations of this company were discontinued on May 5, 1912, and the tracks taken up to make way for the municipal road. The municipal line did not begin traffic operations until just before the close of the year (December 24, 1912), and has not been included as an operating road. At the close of the year, therefore, the total cable trackage in operation was 49.48 miles, consisting of 11.70 miles of inclined-plane cable and 37.78 miles of street cable.

Traffic.—No distinction as to classes of passengers was made at the census of 1890. Generally, the number reported represented revenue passengers, although in some instances the total of revenue and transfer passengers was reported. It is probable that transfer passengers included were relatively few, and that the total is fairly comparable with the figures for revenue passengers at later censuses. This condition, however, accounts in part for the high average number of revenue passengers per mile of track shown for that year, though it is possible that the proportion of "saturated" trackage in 1890 was greater than in 1902 or 1907, when lines had been built in many communities that could not furnish dense traffic.

It is almost impossible to compile accurate statistics of the territory from which the electric railways of the country draw their traffic. A zone established by an arbitrary radius would be unsatisfactory, and it is impracticable to estimate the population by a personal inspection of the territory traversed by every road or to make a special enumeration for this purpose. Therefore the importance of the electric railways, as indicated by their traffic, can be established in a general way only by comparing, in the case of each geographic division, the number of passengers carried with the total population. Comparisons of this character are given in Table 11.

The Middle Atlantic division ranks first in average number of rides on the basis of total population for each year, and the Pacific division ranks first on the basis of urban population.

STREET AND ELECTRIC RAILWAYS—RELATION OF TRAFFIC TO POPULATION, BY GEOGRAPHIC DIVISIONS: 1890 TO 1912.

Table 11

DIVISION.	Census.	POPULATION.		Number of revenue passengers.	PER CENT OF INCREASE SINCE PRIOR CENSUS.			AVERAGE NUMBER OF REVENUE PASSENGERS PER INHABITANT.			
		Total.	Urban (cities of 8,000 and over, including New England towns).		Population.		Number of revenue passengers.	Total population.	Urban population.	Increase since prior census.	
					Total.	Urban.				Total population.	Urban population.
United States	1912	95,545,336	37,860,711	9,545,554,667	9.3	24.0	28.3	100	252	15	8
	1907	87,455,366	30,525,532	7,441,114,508	10.2	12.8	55.8	85	244	25	68
	1902	79,365,396	27,072,106	4,774,211,904	25.9	46.2	136.0	61	176	28	67
	1890	63,056,438	18,514,564	2,023,010,202	......	......	......	32	109	......	......
GEOGRAPHIC DIVISIONS:											
New England	1912	6,767,513	4,655,256	1,051,161,737	7.7	16.0	20.1	155	226	16	8
	1907	6,281,102	4,013,946	875,115,527	8.4	11.2	36.2	139	218	28	40
	1902	5,794,687	3,610,052	642,546,579	23.1	43.2	210.5	111	178	67	96
	1890	4,708,176	2,521,549	206,907,358	......	......	......	44	82	......	......
Middle Atlantic	1912	20,179,371	12,986,304	3,513,720,591	10.7	17.6	23.8	174	271	18	14
	1907	18,224,327	11,041,010	2,839,019,161	12.0	14.7	43.7	156	257	35	52
	1902	16,269,282	9,623,622	1,975,982,220	27.8	43.6	111.5	121	205	48	66
	1890	12,729,124	6,701,026	934,280,102	......	......	......	73	139	......	......
East North Central	1912	18,757,149	8,626,244	2,159,620,746	6.5	26.2	34.3	115	250	24	15
	1907	17,610,294	6,834,472	1,607,894,497	7.0	4.4	62.2	91	235	31	84
	1902	16,463,438	6,548,298	991,335,624	22.0	62.5	171.0	60	151	33	60
	1890	13,499,198	4,029,132	365,805,163	......	......	......	27	91	......	......
West North Central	1912	11,926,513	3,164,085	787,301,146	5.8	22.6	27.9	66	249	11	10
	1907	11,273,096	2,580,793	615,630,852	6.2	13.2	74.6	55	239	22	84
	1902	10,619,680	2,279,781	352,665,327	18.7	28.0	104.4	33	155	14	58
	1890	8,943,905	1,780,575	172,504,724	......	......	......	19	97	......	......
South Atlantic	1912	12,586,562	2,596,840	616,724,741	7.6	23.2	26.4	49	237	7	5
	1907	11,699,773	2,107,591	487,981,528	8.2	12.8	64.2	42	232	15	73
	1902	10,812,980	1,869,031	297,198,541	21.9	31.4	192.4	27	159	16	88
	1890	8,871,135	1,422,231	101,647,174	......	......	......	11	71	......	......
East South Central	1912	8,602,701	1,248,541	268,785,533	5.3	31.8	21.7	31	215	4	(1)
	1907	8,166,171	946,992	220,887,485	5.6	12.2	87.4	27	233	12	93
	1902	7,729,642	844,036	117,841,573	20.1	39.9	126.5	15	140	7	54
	1890	6,438,475	603,372	52,027,193	......	......	......	8	86	......	......
West South Central	1912	9,288,200	1,527,762	270,745,675	14.0	52.3	40.0	29	177	5	(1)
	1907	8,147,821	1,003,245	193,338,141	16.3	23.3	109.6	24	193	11	80
	1902	7,007,446	813,396	92,262,288	47.3	48.9	100.7	13	113	3	29
	1890	4,755,911	546,225	45,977,833	......	......	......	10	84	......	......
Mountain	1912	2,847,946	717,449	154,224,248	20.6	51.5	36.1	54	215	6	(1)
	1907	2,362,446	473,625	113,304,063	25.9	20.3	83.0	48	239	15	82
	1902	1,876,947	393,828	61,908,903	54.1	52.7	127.4	33	157	11	51
	1890	1,217,776	257,836	27,229,937	......	......	......	22	106	......	......
Pacific	1912	4,589,381	2,338,230	723,270,250	24.4	53.4	48.2	158	309	26	(1)
	1907	3,690,336	1,523,858	487,943,254	32.2	39.8	101.2	132	320	45	98
	1902	2,791,294	1,090,062	242,470,669	47.5	67.0	107.9	87	222	25	43
	1890	1,892,738	652,618	116,630,718	......	......	......	62	179	......	......

[1] Decrease in average number.

Car mileage.—The car-mile is another unit by which to measure growth, although it is affected by changes in car capacity. The passenger-car mileage in 1912 amounted to 1,885,870,157, and in 1907 to 1,583,831,199, an increase of 19.1 per cent, as compared with an increase of 41.4 per cent for the 1902–1907 period; but the percentages of increase in number of revenue passengers for the same periods were 28.3 and 55.9, respectively, while the number of revenue passengers per car-mile increased from 4.26 in 1902 to 4.70 in 1907 and 5.06 in 1912.

Car-hours.—The car-hour is not employed by all roads, but is much more generally used than formerly. In 1912 car-hour statistics were reported by 899 roads, or 92.2 per cent of the total number, as compared with 734, or 77.7 per cent, in 1907, and 390, or 47.7 per cent, in 1902. The increase in density of traffic from census to census, as shown by the average number of revenue passengers per car-hour, namely, 33.28 in 1902, 43.06 in 1907, and 48.38 in 1912, conforms to the growth in traffic density as measured by car-mile unit and by mile of track.

Capitalization.—The statistics of capital stock and funded debt were not fully reported at the census of 1890; in fact, the capitalization and trackage were given for roads controlling only 78.5 per cent of the total mileage. Therefore the figures for that year given in Table 12 are not strictly comparable with those for the three later censuses.

The capitalization of railways includes considerable investments in nonrailway properties. This is especially true of the figures for 1902, 1907, and 1912, which include the capital invested in plants engaged in the generation of electricity for general light and power purposes and in other interests not allied to railway operations. In computing the average capitalization per mile of track, the amounts invested in stock and bonds of other companies, treasury securities, and other permanent investments, have been deducted for 1902, 1907, and 1912, but it is impossible to determine the amount, if any, that should be deducted for 1890. With the exception of those for 1890, the totals include the capitalization for both lessor and operating companies.

Table 12

CAPITALIZATION: 1890 TO 1912.

	1912	1907	1902	1890	Per cent of increase.			
					1902–1912	1907–1912	1902–1907	1890–1902
Capitalization	$4,708,568,141	$3,774,772,096	$2,308,282,099	$449,053,669	104.0	24.7	63.5	414.0
Capital stock	$2,379,346,313	$2,097,708,856	$1,315,572,960	$272,441,843	80.9	13.4	59.5	382.9
Funded debt	$2,329,221,828	$1,677,063,240	$992,709,139	$176,611,826	134.6	38.9	68.9	462.1
Investments in stocks and bonds of other companies, treasury securities, and other permanent investments	$465,250,414	$374,664,197	$152,513,997	(1)	205.1	24.2	145.7	....
Capitalization less investments	$4,243,317,727	$3,400,107,899	$2,155,768,102	....	96.8	24.8	57.7	....
Average capitalization less investments:								
Per mile of line	[2] 141,484	134,961	130,560	98,848	8.4	4.8	3.4	32.1
Per mile of track	[3] 104,930	100,495	96,287	....	9.0	4.4	4.4	....

(1) Figures not available.

[2] 29,991.42 miles of line represented.

[3] 40,439.40 miles of track represented.

Funded debt has formed at each census a proportionately larger part of the capitalization. It does not comprise all of the borrowed capital chargeable to investment, as a large amount of investment capital is represented by short-time notes carried as floating debt, but it is not possible to separate such from other current liabilities. The floating debt reported in 1912 was $296,161,797, an amount equal to 6.3 per cent of the capitalization, as compared with $278,927,097, or 7.4 per cent of the capitalization, in 1907.

The period from 1890 to 1902 covered the change of the most of the roads from animal power to electricity, which accounts for the large increase during this period in capitalization per mile of line and per mile of track. Since 1902 the increase in capitalization per unit has been small and constant.

Income and expenses.—The statistics for income and expenses for 1912 cover all companies, but 6 companies in 1907, 18 in 1902, and a considerable number in 1890 did not report these data.

Table 13 shows the revenue constituents of the gross income and the distribution of income by leading items of expenditure for each census from 1890 to 1912, inclusive.

Table 13

DISTRIBUTION OF GROSS INCOME OF OPERATING COMPANIES.

	Amount.				Per cent.			
	1912	1907	1902	1890	1912	1907	1902	1890
Gross income of operating companies	$585,930,517	$429,744,254	$250,504,627	$91,721,845	100.0	100.0	100.0	100.0
Operating revenues	567,511,704	418,187,858	247,553,999	90,617,211	96.8	97.3	98.8	98.8
Passenger	502,651,637	382,132,494	233,821,548	89,711,830	85.7	88.9	93.3	97.8
Other	64,860,067	36,055,364	13,732,451	905,381	11.1	8.4	5.5	1.0
Income from other sources	18,418,813	11,556,396	2,950,628	1,104,634	3.2	2.7	1.2	1.2
Distribution:								
Operating expenses	332,896,356	251,309,252	142,312,597	62,011,185	56.8	58.5	56.8	67.6
Deductions	191,123,408	138,094,716	77,595,053	13,978,903	32.6	32.1	31.0	15.2
Taxes	35,027,965	19,755,602	13,078,899	3,308,190	6.0	4.6	5.2	3.6
Interest on funded and floating debt and mortgages	98,025,338	63,740,744	38,085,911	8,086,216	16.7	14.8	15.2	8.8
Rent of leased lines and terminals	44,784,521	48,022,596	25,518,225	2,561,343	7.6	11.2	10.2	2.8
Miscellaneous	13,285,584	6,575,774	912,018	23,154	2.3	1.5	0.4	(1)
Dividends	51,650,117	26,454,732	15,882,110	10,180,726	8.8	6.2	6.3	11.1
Miscellaneous payments	....	....	....	1,217,193	....	....	....	1.3
Surplus	10,260,636	13,885,554	14,714,867	4,333,838	1.8	3.2	5.9	4.8

(1) Less than one-tenth of 1 per cent.

An estimate based on a 5-cent fare per passenger carried in 1890 would increase the operating revenues for that year to the neighborhood of $100,000,000, as compared with $247,553,999 in 1902, $418,187,858 in 1907, and $567,511,704 in 1912. However, this comparison, like those for practically all of the items shown for the census of 1890 and the later censuses, is indicative rather than exact, as it was apparently impossible to obtain complete reports at the first census of the industry.

There is shown a noticeable increase in operating income other than passenger, due to growth of freight, mail, and express business and the sale of current. The income from passenger service formed 99 per cent of the total income from operation in 1890, but this proportion decreased to 94.5 per cent in 1902, 91.4 per cent in 1907, and 88.6 per cent in 1912. The percentage that the income from other sources formed of the gross income was 1.2 in both 1890 and 1902, 2.7 in 1907, and 3.2 in 1912. With the introduction of electric traction during the period 1890–1902 there came a marked drop in the operating ratio, that is, the ratio of operating expenses to operating revenues. This fell from 73.7 per cent for horse roads and 68.4 per cent for all roads in 1890 to 57.5 per cent in 1902. The average operating ratio in 1912 was 58.7 per cent. But offsetting the fall in the operating ratio there was a counterbalancing rise in the ratio for deductions from income, which rose from 15.2 per cent in 1890 to 31 per cent in 1902, and increased slightly at each of the later censuses. The per cent distribution of the fixed charges is given in the next tabular statement, interest ranking first, followed by rentals and then taxes, except in 1890, when taxes exceeded rentals.

	PER CENT DISTRIBUTION OF FIXED CHARGES.			
	1912	1907	1902	1890
Total	100.0	100.0	100.0	100.0
Taxes	18.3	14.3	16.8	23.7
Interest	51.3	46.1	49.1	57.8
Rentals	23.4	34.8	32.9	18.3
Miscellaneous	7.0	4.8	1.2	0.2

After 1907 there was a decrease, both actual and proportionate, in rentals for leased lines and terminals, though prior to 1907 there had been a progressive increase in this item of expense. In harmony therewith there was a decrease in number of lessor companies from 1907 to 1912, and an increase for the period prior thereto, although the leased mileage shows an increase from 1907 to 1912 as well as for the prior periods.

Table 14 shows the percentage of income absorbed by invested capital and that consumed by expense other than that representing return on capital investment. Returns on invested capital include dividends, interest paid on funded debt, etc., and rentals paid for leased lines and terminals, which are disbursed by the lessor companies to their stock and bond holders.

Table 14	PER CENT DISTRIBUTION OF INCOME BETWEEN EXPENSES AND INVESTED CAPITAL.			
	1912	1907	1902	1890
Gross income of operating companies	100.0	100.0	100.0	100.0
Expenses other than interest and rentals	65.1	64.6	62.4	72.5
Operating expense	56.8	58.5	56.8	67.6
Other expenses	8.3	6.1	5.6	4.9
Returns on invested capital	33.1	32.2	31.7	22.7
As interest on funded and floating debt and mortgages	16.7	14.8	15.2	8.8
As rent of leased lines and terminals	7.6	11.2	10.2	2.8
As dividends	8.8	6.2	6.3	11.1
Surplus	1.8	3.2	5.9	4.8

Although the percentages for the subitems fluctuate somewhat for the different years, the group percentages have a uniform trend.

Employees.—The number of wage earners employed on September 16, 1912, was taken as representing under general conditions an average of the number required to operate the railway systems. At the prior censuses the numbers reported by the companies were their estimates of the average numbers employed during the year. The number of salaried employees was not fully reported in 1890. At the census of 1902, 20 companies operating 417.03 miles of track, and in 1907, 6 companies, with 292.95 miles of track, failed to report the number of employees.

The average number of revenue passengers carried per employee, in 1912, 1907, and 1902, varied but little, although there was a marked increase in the number of salaried employees as compared with that of wage earners for the period 1907–1912. This may be due in part to the inclusion under salaried employees in 1912 of certain classes of men reported as wage earners in 1907.

In 1907 the schedule specified the various classes of employees to be reported as wage earners, namely, foremen, inspectors, starters, dynamo and switchboard men, engineers, electricians (skilled), etc., as well as conductors and motormen, but the schedule for 1912 only asked under this heading for conductors, motormen, and all other wage earners. On the basis of conductors and motormen employed, the average number of revenue passengers shows a steady increase. The averages are shown in the following tabular statement:

CENSUS.	AVERAGE NUMBER OF REVENUE PASSENGERS.		PER CENT OF INCREASE.[1]	
	Per employee.	Per conductor and motorman.	Per employee.	Per conductor and motorman.
1912	33,794	72,689	0.6	12.8
1907	33,605	64,415	−0.9	8.1
1902	33,915	59,570		

[1] A minus sign (−) denotes decrease.

The following diagrams and maps illustrate graphically certain of the statistics for the years 1912, 1907, and 1902. Diagram 1 shows the miles of track by states, excluding states with less than 100 miles of track in 1912. The data upon which this diagram is based are given in Table 153 (p. 282).

DIAGRAM 1.—MILES OF TRACK, BY STATES: 1912, 1907, AND 1902.

[States with 100 miles of track in 1912—Based upon net trackage in states.]

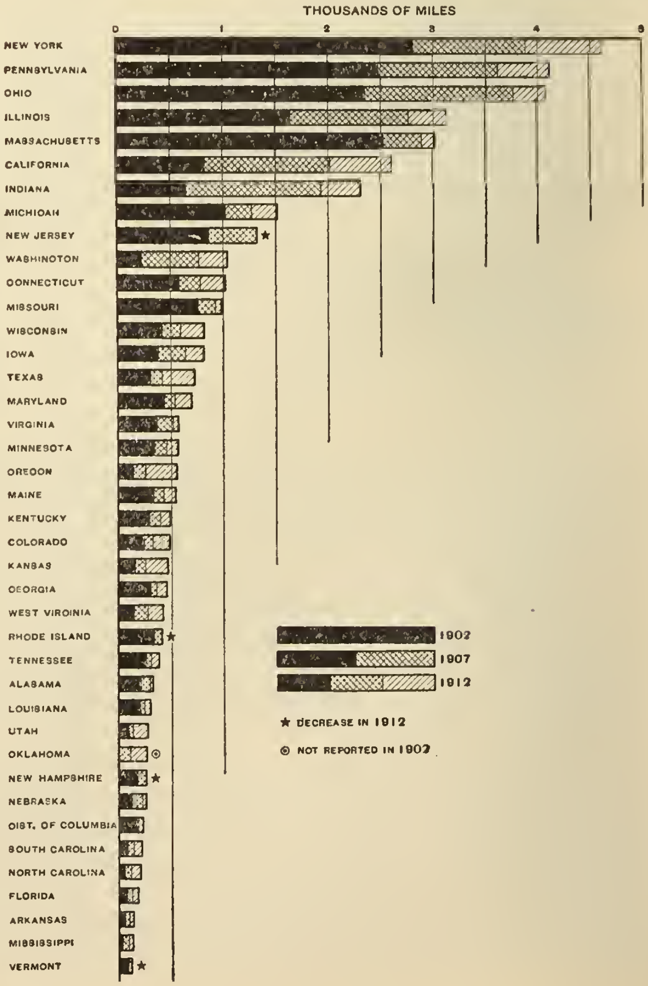


Diagram 2 shows the number of revenue passengers by states, excluding states having less than 20,000,000 revenue passengers in 1912. The data upon which this diagram is based are given in Table 156 (p. 292).

Diagram 2.—Number of Revenue Passengers, by States: 1912, 1907, and 1902.

[States with 20,000,000 revenue passengers in 1912—Based on total for companies credited to the several states.]

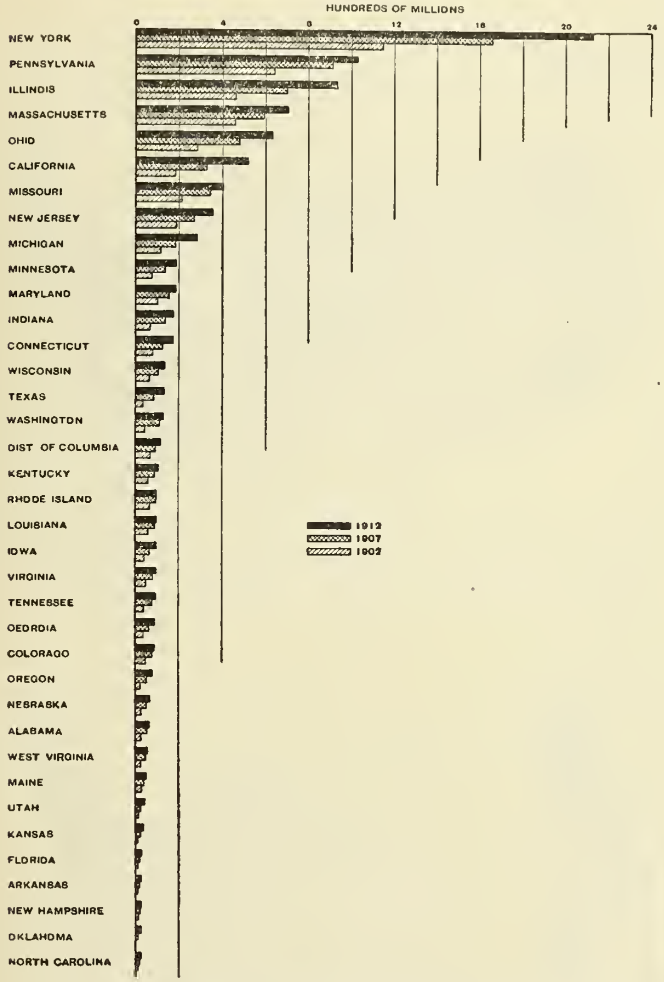
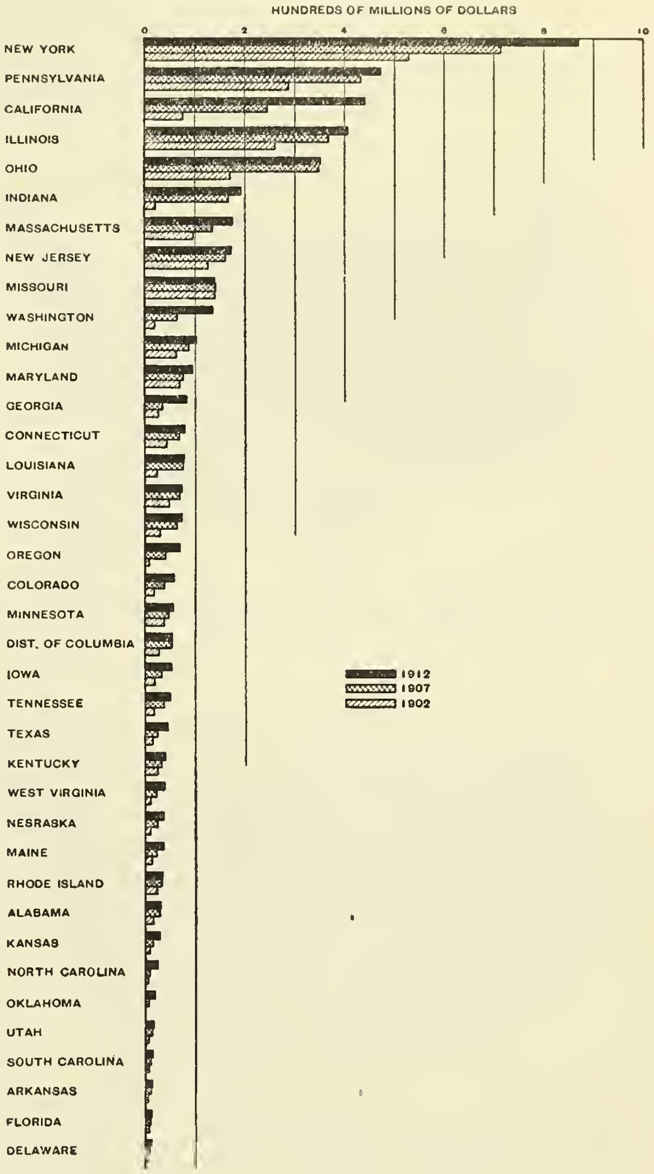


Diagram 3 shows the capitalization of all companies by states, excluding states having less than $10,000,000 of capitalization in 1912. The data upon which this diagram is based are given in Table 157 (p. 299).

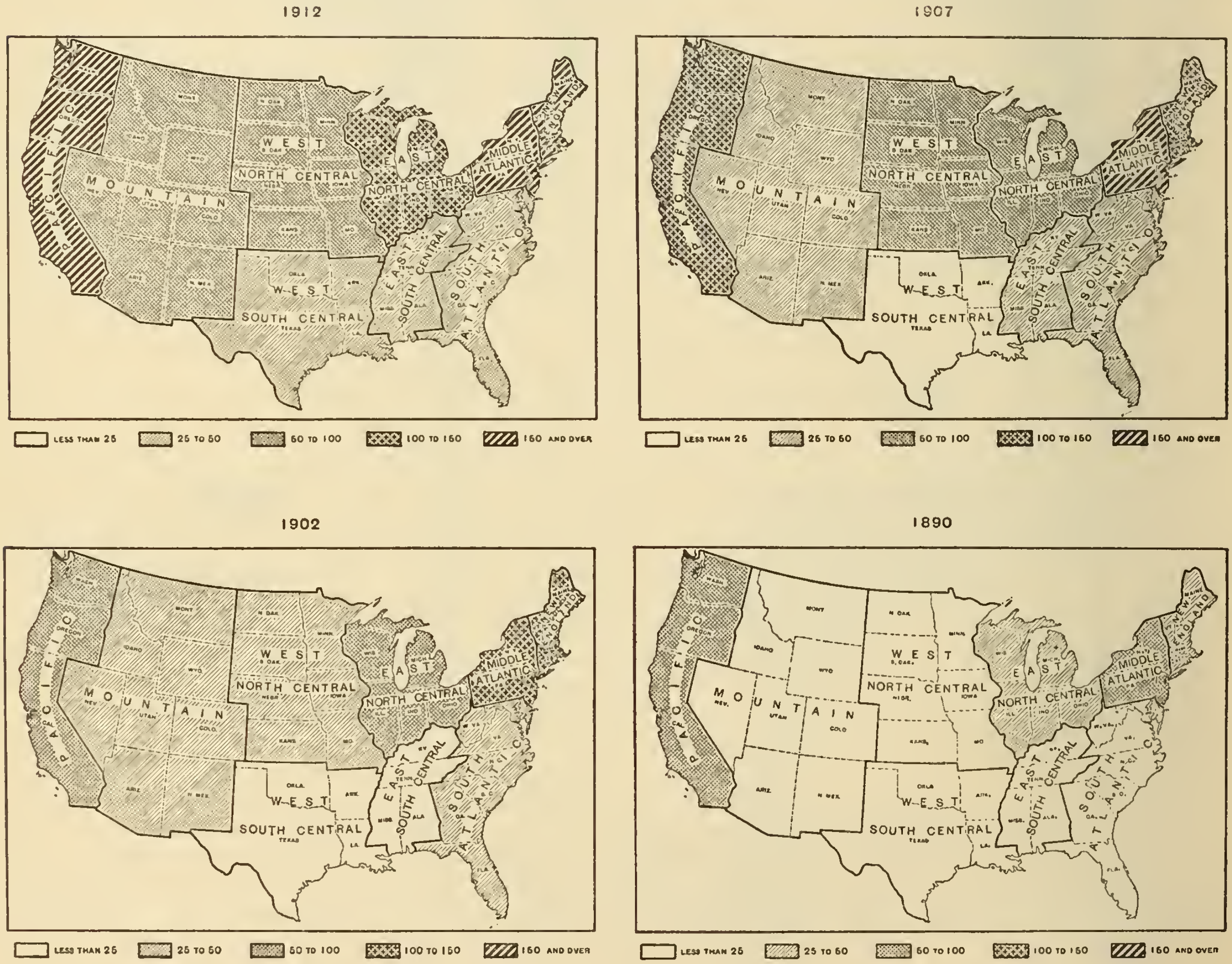
The maps show the average number of revenue passengers per inhabitant, by geographic divisions, for 1912, 1907, 1902, and 1890. The data upon which the maps are based are given in Table 11 (p. 190).

Diagram 3.—Capitalization Outstanding of Operating and Lessor Companies Combined, by States: 1912, 1907, and 1902.

[States with $10,000,000 of outstanding capitalization in 1912.]



MAPS SHOWING AVERAGE NUMBER OF REVENUE PASSENGERS PER INHABITANT, BY GEOGRAPHIC DIVISIONS: 1912, 1907, 1902, AND 1890.


1912
1907
1902
1890
PACIFIC
MOUNTAIN
WEST NORTH CENTRAL
EAST NORTH CENTRAL
MIDDLE ATLANTIC
NEW ENGLAND
WEST SOUTH CENTRAL
EAST SOUTH CENTRAL
SOUTH ATLANTIC
LESS THAN 25
25 TO 50
50 TO 100
100 TO 150
150 AND OVER

CHAPTER III.

POWER EQUIPMENT AND OUTPUT OF STATIONS.

Traffic and financial operations are, perhaps, the more important features of the railway industry, but the physical equipment of the roads naturally takes precedence. The power plant is the primary equipment unit, and statistics concerning it will be presented in advance of those for track and rolling stock. The following discussion considers the data for all companies, the comparison of statistics being confined to the years 1912, 1907, and 1902 because in 1890 there were comparatively few electric roads in operation and the information concerning them was not complete.

The following table shows the number of companies using the several kinds of power in 1912:

Table 15

KIND OF POWER.	NUMBER OF COMPANIES, CLASSIFIED ACCORDING TO KIND OF POWER: 1912.		
	Total for each kind.	Kind indicated, exclusively.	Mixed power—electric and other kind.
Electric	[1] 943	[1] 925	[2] 18
Cable	[3] 21	13	8
Animal	[3] 13	9	4
Gasoline motor	9	8	1
Steam	9	1	8

[1] Includes one gas-electric.
[2] Total number of companies with mixed power—electric and other kinds.
[3] One company part cable and part animal.

Electricity was used wholly or in part by 943 companies, or 96.7 per cent of the total number, in 1912, as compared with 904, or 95.7 per cent, in 1907. In 1912, however, the majority of the companies did not operate power plants but purchased power, while in 1907, 57 per cent of the companies operated power plants, and in 1902, 66.6 per cent.

Table 16 shows the number of companies with and without power plants, classified according to kind of motive power.

In 1912, 31 companies having power equipment reported that it was not operated during 1912, current having been purchased from central stations or other railway companies. The idle equipment is included in the general tables for power equipment, but the number of companies with power plants in Table 16 refers to operated plants. In 1907, 37 companies had idle equipment and in 1902, 33 companies.

Table 16

CHARACTER OF POWER.	COMPANIES WITH AND WITHOUT POWER PLANT EQUIPMENT, CLASSIFIED ACCORDING TO CHARACTER OF POWER.		
	1912	1907	1902
Total number	975	945	817
With operated power plants	463	539	544
Electric exclusively	446	518	511
Current generated	441	515	498
Steam power rented, current generated	5	3	13
Electric and other power	11	14	20
Cable exclusively	6	7	[1] 13
Without operated power plants [2]	512	406	273
Electric current purchased	485	371	216
Electric exclusively	477	[3] 363	[3] 210
Electric and other power	8	8	6
Gas-electric motors exclusively	1	1	....
Gasoline motors exclusively	8	5	....
Cable exclusively, power rented	8	3	1
Animal exclusively	9	23	53
Steam exclusively	1	3	3
Per cent of total	100.0	100.0	100.0
With power plants	47.5	57.0	66.6
Electric exclusively	45.7	54.8	62.5
All other	1.8	2.2	4.1
Without power plants	52.5	43.0	33.4
Electric current purchased	49.7	39.3	26.4
All other	2.8	3.7	7.0

[1] Includes 1 company using cable and other than electric power, and 1 using compressed air.
[2] Includes 31 companies in 1912, 37 in 1907, and 33 in 1902 with idle power plants, current purchased.
[3] Includes 1 company operating with storage batteries.

Table 17 shows, for 1912, 1907, and 1902, the number of companies having power plants, including idle equipment; the number, kind, and capacity of the primary power units of the electric generators or dynamos, and of the various units comprised in the subsidiary apparatus; the quantity of current generated and purchased; and the percentages of increase for the census periods.

In 1912, 50.8 per cent of the street and electric railways had their own power-plant equipment, as compared with 61 per cent in 1907 and 70.6 per cent in 1902; or, in other words, the number of operating companies without power plants has increased from 240, or 29.4 per cent of the total number in 1902, to 480, or 49.2 per cent of the total number in 1912.

The statistics for the equipment of roads operated by power supplied from central power plants in 1890 were not complete, although 358 steam engines with 79,387 horsepower were returned, the larger portion thereof being reported as used in the operation of cable systems.

STREET AND ELECTRIC RAILWAYS—POWER-PLANT EQUIPMENT AND OUTPUT OF STATIONS.

Table 17	1912	1907	1902[1]	PER CENT OF INCREASE.[2]		
				1902–1912	1907–1912	1902–1907
Number of operating companies	975	945	817	19.3	3.2	15.7
Number of companies with power-plant equipment	495	576	577	−14.2	−14.1	−0.2
Primary power:						
Number of units	2,695	3,637	2,811	−4.1	−25.9	29.4
Horsepower	3,665,051	2,519,823	1,359,285	169.6	45.4	85.4
Steam power—						
Number of units	2,264	3,368	2,637	−14.2	−32.8	27.7
Horsepower	3,169,554	2,411,527	1,308,207	142.3	31.4	84.3
Engines—						
Number	1,802	3,116	(3)	....	−42.2	....
Horsepower	1,706,754	1,876,123	(3)	....	−9.0	....
Turbines—						
Number	462	252	(3)	....	83.3	....
Horsepower	1,462,800	535,404	(3)	....	173.2	....
Gas and oil engines—						
Number	48	41	15	220.0	17.1	173.3
Horsepower	24,190	16,335	1,925	1,156.6	48.1	748.6
Water wheels and turbines—						
Number	383	228	159	140.9	68.0	43.4
Horsepower	471,307	91,961	49,153	858.9	412.5	87.1
Dynamos:						
Number	2,797	3,124	3,302	−15.3	−10.5	−5.4
Kilowatt capacity	2,508,066	1,723,416	898,362	179.2	45.5	91.8
Direct current—						
Number	1,642	2,192	2,861	−42.6	−25.1	−23.4
Kilowatt capacity	769,875	941,502	725,346	6.1	−18.2	29.8
Alternating and polyphase current—						
Number	1,155	932	441	161.9	23.9	111.3
Kilowatt capacity	1,738,191	781,914	173,016	904.6	122.3	351.9
Subsidiary equipment:						
Rotary converters and motor generator sets—						
Number	2,840	1,862	[4] 441	544.0	52.5	322.2
Kilowatt capacity	1,637,260	942,232	160,053	922.9	73.8	488.7
Boosters—						
Number	183	134	[5] 104	76.0	36.6	28.8
Kilowatt capacity	24,807	17,046	13,666	81.5	45.5	24.7
Transformers—						
Number	8,436	5,274	[6] 1,657	409.1	60.0	218.3
Kilowatt capacity	2,357,397	1,133,161	212,569	1,009.0	108.0	433.1
Auxiliary generators—						
Number	144	311	[7] 71	102.8	−53.7	338.0
Kilowatt capacity	12,227	19,152	3,763	224.9	−36.2	409.0
Output of stations and current purchased, kilowatt hours:						
Generated	6,052,699,008	4,759,130,100	2,261,484,397	167.6	27.2	110.4
Purchased	2,967,318,781	(8)	(8)	....	....	....

[1] Totals do not include 1 electric motor of 150 horsepower reported as primary power.
[2] A minus sign (−) denotes decrease.
[3] Not reported separately.
[4] Exclusive of 8 rotary converters for which capacity was not reported.
[5] Exclusive of 3 boosters for which capacity was not reported.
[6] Exclusive of 23 transformers for which capacity was not reported.
[7] Exclusive of 1 auxiliary generator for which capacity was not reported.
[8] Figures not available.

The aggregate capacity of all primary motive power reported by the street and electric railways increased during the decade 1902–1912 from 1,359,285 to 3,665,051 horsepower, or 169.6 per cent, and the capacity of the electric generators or dynamos from 898,362 to 2,508,066 kilowatts, or 179.2 per cent. The capacity of all dynamos reduced to horsepower was equal to 91.2 per cent of the capacity of the primary power equipment in 1912, as compared with the same ratio in 1907 and 88.1 per cent in 1902. This comparison, however, is only approximate, as not all of the primary power is employed for electric generation.

Table 18 gives the average indicated capacity of all classes of power units for 1912, 1907, and 1902:

Table 18 KIND.	AVERAGE INDICATED POWER CAPACITY PER UNIT.		
	1912	1907	1902
Primary power, all units (horsepower)	1,360	693	484
Steam power	1,400	716	496
Engines	947	602	....
Turbines	3,166	2,125	....
Gas and oil engines	504	398	128
Water wheels and turbines	1,231	403	309
Dynamos (kilowatts)	897	552	272
Direct current	469	430	254
Alternating or polyphase current	1,505	839	392

The number and horsepower of auxiliary engines were not reported separately in 1912, and those reported in 1907 and 1902 have been treated as steam engines for comparative purposes. The average horsepower per steam unit increased from 496 in 1902 to 1,400 in 1912. The horsepower of steam engines shows a marked decrease, the development of steam power being confined to the installation of large turbines. Steam turbines were not reported separately in 1902, but in 1907 they averaged 2,125 horsepower per unit and in 1912, 3,166. The development of the larger stations is further shown by the figures for water wheels and turbines, the average size of which increased from 309 horsepower in 1902 to 1,231 in 1912. Dynamos increased in kilowatt capacity more than threefold during the 10-year period, almost all of the increase being in alternating and polyphase current generators.

Table 19 shows the per cent distribution of power, by kind, for the three census years.

A marked feature is the growth in steam turbines, in water power, and in alternating and polyphase current dynamos. There were few, if any, steam turbines in 1902 and they were not reported separately, but from 1907 to 1912 the horsepower of the steam turbines increased 173.2 per cent and the horsepower of the water wheels and turbines 412.5 per cent. The increase for the decade 1902–1912 in water power was from 49,153 horsepower to 471,307 horsepower, or more than eightfold, and in alternating and polyphase current dynamos, from 173,016 kilowatts to 1,738,191 kilowatts, or more than ninefold.

Table 19

KIND.	PER CENT DISTRIBUTION OF TOTAL INDICATED POWER CAPACITY.		
	1912	1907	1902
Primary power	100.0	100.0	100.0
Steam power	86.5	95.7	96.2
Engines	46.6	74.5	...
Turbines	39.9	21.2	...
Gas and oil engines	0.7	0.1	0.1
Water wheels and turbines	12.9	3.6	3.6
Dynamos	100.0	100.0	100.0
Direct current	30.7	54.6	80.7
Alternating and polyphase current	69.3	45.4	19.3

The growth in subsidiary or substation equipment, under which heading is included all equipment for manipulating current, whether in the main station or at outside points, has been in keeping with the growth in power. The increase in capacity of the alternating and polyphase current dynamos during the period 1902–1912 was 905 per cent, the increase in capacity of rotary converters and motor generator sets 923 per cent, and in capacity of transformers a little over 1,000 per cent.

The rapid extension of the use of large power units is evidenced by the statistics given in Table 20, which shows the total number of units and the total primary power for the United States, and the number and horsepower of steam engines and turbines, gas and oil engines, and water wheels and turbines, grouped according to the indicated horsepower of the separate machines. These data cover the three censuses, 1912, 1907, and 1902, and include the percentages of increase for the two periods and the decade.

Table 20

KIND.	PRIMARY POWER, MACHINES, NUMBER, KIND, AND HORSEPOWER: 1912, 1907, AND 1902.									
	Number of units.	Total horsepower.	Power units grouped according to horsepower.							
			500 horsepower or under.		Over 500 and under 2,000 horsepower.		2,000 and under 5,000 horsepower.		5,000 horsepower and over.	
			Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.
Total:										
1912	2,695	3,665,051	1,162	333,374	1,039	1,047,001	346	960,281	148	1,324,395
1907	[1] 3,637	[1] 2,519,823	[1] 2,348	[1] 464,217	970	933,480	250	699,926	69	422,200
1902	[2] 2,811	[2] 1,359,285	[2] 2,034	[2] 455,503	777	903,872	(3)	(3)	(3)	(3)
Steam power:										
1912	2,264	3,169,554	925	272,892	907	915,186	312	871,281	120	1,110,195
1907	[1] 3,368	[1] 2,411,527	[1] 2,142	[1] 423,019	910	874,682	247	691,626	69	422,200
1902	[2] 2,637	[2] 1,308,207	[2] 1,890	[2] 431,125	747	877,082	(3)	(3)	(3)	(3)
Engines—										
1912	1,802	1,706,754	892	264,628	704	697,017	167	432,859	39	312,250
1907	[1] 3,116	[1] 1,876,123	[1] 2,119	[1] 419,231	789	755,404	162	458,488	46	243,000
Turbines[4]—										
1912	462	1,462,800	33	8,264	203	218,169	145	438,422	81	797,945
1907	[1] 252	535,404	23	3,788	121	119,278	85	233,138	23	179,200
Gas and oil engines:										
1912	48	24,190	32	8,390	13	8,800	3	7,000	...	...
1907	41	16,335	34	8,435	5	2,900	2	5,000	...	...
1902	15	1,925	15	1,925	...	...	...	...	...	...
Water wheels and turbines:										
1912	383	471,307	205	52,092	119	123,015	31	82,000	28	214,200
1907	228	91,961	172	32,763	55	55,898	1	3,300	...	...
1902	159	49,153	129	22,453	30	26,700	...	...	...	...
	PER CENT OF INCREASE.[5]									
Total:										
1902 to 1912	−4.1	169.6	−42.9	−26.8	33.7	15.8	...	...	...	...
1907 to 1912	−25.9	45.4	−50.5	−28.2	7.1	12.2	38.4	37.2	114.5	213.7
1902 to 1907	29.4	85.4	15.4	1.9	24.8	3.3	...	...	...	...
Steam power:										
1902 to 1912	−14.1	142.3	−51.1	−36.7	21.4	4.3	...	...	...	...
1907 to 1912	−32.8	31.4	−56.8	−35.5	−0.3	4.6	26.3	26.0	73.9	163.0
1902 to 1907	27.7	84.3	13.3	−1.9	21.8	−0.3	...	...	...	...
Engines—										
1907 to 1912	−42.2	−9.0	−57.9	−36.9	−10.8	−7.7	3.1	−5.6	−15.2	28.5
Turbines—										
1907 to 1912	83.3	173.2	43.5	118.2	67.8	82.9	70.6	88.1	252.2	345.3
Gas and oil engines:										
1902 to 1912	220.0	1,156.6	113.3	335.8	...	...	...	...	...	...
1907 to 1912	17.1	48.1	−5.9	−0.5	160.0	203.4	50.0	40.0	...	...
1902 to 1907	173.3	748.6	126.7	338.2	...	...	...	...	...	...
Water wheels and turbines:										
1902 to 1912	140.9	858.9	58.9	132.0	296.7	360.7	...	...	...	...
1907 to 1912	68.0	412.5	19.2	59.0	116.4	120.1	...	...	...	...
1902 to 1907	43.4	87.1	33.3	45.9	83.3	109.4	...	...	...	...

[1] Includes 857 units of 43,344 horsepower reported as auxiliary engines.
[2] Includes 301 units of 10,074 horsepower reported as auxiliary steam engines.
[3] Included in "500 and under 2,000 horsepower;" engines over 2,000 horsepower not reported separately in 1902.
[4] Steam turbines included with steam engines in 1902.
[5] A minus sign (—) denotes decrease.

In 1912, 62.3 per cent of the power was in units of 2,000 horsepower or over, compared with 44.5 per cent in 1907.

Steam is the predominating primary power, although the number of companies using steam power has decreased and the number using water power and internal-combustion engines has increased. Table 21 shows the number of companies with power plants classified according to kind of primary power for 1912, 1907, and 1902.

Table 21

KIND.	COMPANIES CLASSIFIED ACCORDING TO KIND OF PRIMARY POWER EQUIPMENT (NUMBER).		
	1912	1907	1902
Total number with power plants	495	576	577
Steam exclusively	425	476	500
Water exclusively	6	8	6
Gas exclusively	9	8	3
Steam and water	46	39	32
Steam and gas	8	8	3
Steam, water, and gas	1	...	...
Total number using—			
Steam	480	523	535
Water	53	47	38
Gas	18	16	6

The presence of mixed equipment does not necessarily mean that more than one kind of power is ordinarily used. One may be held in reserve, particularly in the case of water power along with steam or gas.

Table 22 shows the power and output of stations for all companies, classified according to income from railway operations, for 1912, 1907, and 1902.

Companies of class A (those having an income of $1,000,000 and over from railway operations) constituted 9.3 per cent of all companies in 1912, as compared with 5.4 per cent in 1902, and companies of class B (those having an income from railway operations of $250,000 but less than $1,000,000) 15.9 per cent in 1912, as compared with 10.4 per cent in 1902, while companies of class C (those having an income less than $250,000 from railway operations) constituted 74.8 per cent in 1912, as compared with 84.2 per cent in 1902. Of the total number of operating companies in 1912, 50.8 per cent generated power, but for class A the ratio was 90.1 per cent, as compared with 64.5 per cent for class B and 42.9 per cent for class C.

Nearly three-fifths (58.9 per cent) of the water power was reported by companies of class A for 1912, as compared with 14.9 per cent for 1907 and 22.1 per cent for 1902, while class C reported 63.3 per cent of the water power for 1907 and 75.1 per cent for 1902. The lower group, or class C, shows the largest amount of gas power in all three years—37.7 per cent in 1912, 54.8 per cent in 1907, and 79.2 per cent in 1902.

Table 151 (p. 278) gives the statistics for primary power, by geographic divisions and states, for 1912.

Table 22

POWER AND OUTPUT OF STATIONS FOR COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS: 1912, 1907, AND 1902.

CLASSIFICATION GROUP.	Number of operating companies.	Number of companies with power plants.	Primary horsepower.				Dynamos—kilowatt capacity.			Output of stations—kilowatt hours.
			Total.	Steam engines and turbines.	Gas and oil engines.	Water wheels and turbines.	Total.	Direct current.	Alternating and polyphase current.	
Total:										
1912	975	495	3,665,051	3,169,554	24,190	471,307	2,508,066	769,875	1,738,191	6,052,699,008
1907	945	576	2,476,479	2,368,183	16,335	91,961	1,723,416	941,502	781,914	4,759,130,100
1902	817	577	1,349,211	1,298,133	1,925	49,153	898,362	725,346	173,016	2,261,484,397
Class A—$1,000,000 and over:										
1912	91	82	2,573,122	2,288,643	6,790	277,689	1,739,980	497,667	1,242,313	3,559,068,286
1907	77	(1)	1,596,880	1,577,444	5,740	13,696	1,096,101	607,191	488,910	3,491,483,244
1902	44	(1)	736,832	725,560	400	10,872	477,101	393,926	83,630	1,421,910,468
Class B—$250,000 but less than $1,000,000:										
1912	155	100	595,892	474,198	8,290	113,404	416,959	137,157	279,802	945,257,949
1907	132	(1)	382,514	360,844	1,650	20,020	268,659	140,364	128,205	662,994,538
1902	85	(1)	224,293	222,948	...	1,345	154,069	129,769	24,300	406,944,956
Class C—less than $250,000:										
1912	729	313	496,037	406,713	9,110	80,214	351,127	135,051	216,076	1,548,372,773
1907	736	(1)	497,085	429,895	8,945	58,245	358,656	193,947	164,709	604,652,318
1902	688	(1)	388,086	349,625	1,525	36,936	266,737	201,651	65,086	432,628,973

[1] Figures not available.

There were 2,695 primary power units reported for street and electric railways. Of this number, 2,264 were steam units (1,802 engines and 462 turbines); 48, gas or oil engines; and 383, water wheels.

The distribution of the number of primary power units and indicated horsepower according to size of units has been given in Table 20 in connection with similar statistics for prior censuses.

The steam turbine is an interesting feature of the power equipment. This type of steam engine represented in 1912 nearly 40 per cent of the primary power and 60 per cent of the power developed by units of 5,000 horsepower and over.

Table 152 (p. 280) gives in detail the statistics relating to electric generating and subsidiary or substation equipment, including output of stations and quantity of current generated in 1912, by geographic divisions and states.

The dynamos aggregated 2,797 in number, with a capacity rating of 2,508,066 kilowatts. Of these, 58.7 per cent in number and 30.7 per cent in capacity were direct-current, and 41.3 per cent in number and 69.3

per cent in capacity were alternating- or polyphase-current machines.

The 6,052,699,008 kilowatt hours of current generated is equal to the output of the entire equipment at rated capacity for an average of 6.6 hours per day for the year. More or less current was purchased in every state, and in South Dakota, New Mexico, Idaho, Wyoming, and Nevada all current was purchased.

The 2,967,318,781 kilowatt hours of current purchased includes intercompany sales of current as well as current purchased from central electric power stations; hence the aggregate of current generated and current purchased includes some duplication, the amount of which it is impossible to determine. The amount paid for purchased power was $24,546,530, which indicates an average cost of approximately 0.83 cent per kilowatt hour. The operating power expense reported by the railway companies indicates an operative cost of production for current generated of approximately 0.59 cent per kilowatt hour.

On account of the mixed railway and light and power operations of many companies, operating ratios involving cost of current consumption can not be deduced from the returns as a whole, but Table 23 presents statistics derived from the reports of 130 companies that neither bought nor sold current in 1912, in comparison with ratios based upon the reports of 176 similar companies in 1907.

Table 23

ELECTRIC RAILWAYS THAT NEITHER BOUGHT NOR SOLD CURRENT: MILES OF TRACK, POWER, PASSENGERS CARRIED, AND CAR MILEAGE, 1912, AND OPERATING RATIOS, 1912 AND 1907.

	United States	Massachusetts and Connecticut.	New York, New Jersey, and Pennsylvania.	Illinois, Indiana, Ohio, and Wisconsin.	All other states.[1]
Number of companies	130	10	51	26	43
Miles of track	4,276.98	274.93	1,828.88	1,047.51	1,125.66
Power:					
Primary horsepower	727,826	13,540	505,014	128,130	81,142
Dynamos (kilowatt capacity)	509,720	9,210	351,259	90,083	59,168
Output of stations (kilowatt hours)	1,258,241,204	19,951,180	960,112,531	151,884,498	126,292,995
Cost of operating power plants	$6,881,819	$225,445	$4,664,807	$952,696	$1,038,871
Passengers carried:					
Total	1,876,179,388	31,844,689	1,388,124,889	201,864,591	254,345,219
Revenue	1,613,112,449	29,425,674	1,226,283,661	153,850,623	203,552,491
Transfer	253,672,918	2,365,467	157,839,890	46,063,700	47,403,861
Free	9,394,021	53,548	4,001,338	1,950,268	3,388,867
Revenue car mileage:					
Total	331,082,917	6,173,738	247,816,231	34,143,394	42,949,554
Passenger	328,505,324	6,070,935	246,539,177	33,358,643	42,536,569
Express, mail, and freight	2,577,593	102,803	1,277,054	784,751	412,985
Operating ratios:[2]					
Revenue passengers—					
Per mile of track—					
1912	377,162	107,030	670,511	146,873	180,829
1907	268,050	86,860	363,570	202,226	246,979
Per passenger-car-mile—					
1912	4.91	4.85	4.97	4.61	4.79
1907	4.92	4.34	5.12	4.39	5.02
Kilowatt consumption per car-mile—					
1912	3.80	3.23	3.87	4.45	2.94
1907	3.26	3.10	3.39	3.08	3.21
Cost of current per kilowatt hour (cents)—					
1912	0.55	1.13	0.49	0.63	0.82
1907	0.65	1.13	0.58	0.68	0.72

[1] Includes companies as follows: Alabama, 1; Arkansas, 1; California, 2; Colorado, 1; Delaware, 1; District of Columbia, 1; Florida, 2; Iowa, 1; Kansas, 3; Kentucky, 2; Louisiana, 3; Maryland, 2; Michigan, 2; Missouri, 3; Montana, 1; New Hampshire, 1; North Carolina, 1; North Dakota, 1; Oklahoma, 2; Tennessee, 1; Texas, 4; Vermont, 2; Virginia, 2; and West Virginia, 3.

[2] Operating ratios for 1907 are based upon returns for 176 companies with 7,341.73 miles of track.

Ratio deductions must necessarily be of a general character, as even the companies that did railway business solely and neither bought nor sold current are not on equal footing in regard to current consumption.

The lighting and heating of cars is now chiefly electric, though in earlier years other methods were largely used, but the consumption of current for car heating is, of course, proportionately greatest in the northern districts.

The companies represented by the statistics in 1912 and 1907 are not in all cases the same, and the density of traffic measured by the number of revenue passengers per mile of track shows marked variations, due to the inclusion or exclusion in 1912 or 1907, as the case may be, of companies operating in thickly settled districts; but the resulting ratios of revenue passengers per passenger-car-mile, kilowatt consumption per car-mile, and cost of current per kilowatt hour show but slight changes for the two years.

CHAPTER IV.

TRACK AND ROLLING STOCK.

TRACK.

The track operated by the companies embraced in the census of street and electric railways includes not only the first, second, and other main tracks, but also sidings, turnouts, and track in car barns, storage yards, etc. The length of these various kinds of track, in single-track miles, amounted to 41,064.82 miles in 1912, as compared with 34,403.56 miles in 1907 and 22,572.52 miles in 1902. The increase from 1902 to 1912 amounted to 18,492.30 miles, or 81.9 per cent.

Table 153 (p. 282) gives the statistics in detail for track mileage, by geographic divisions and states, for 1912, 1907, and 1902.

Table 24 gives, for the United States, the statistics pertaining to operated trackage for 1912, 1907, and 1902, with percentages of increase.

STREET AND ELECTRIC RAILWAYS—TRACK MILEAGE, CLASSIFIED BY CHARACTER OF MOTIVE POWER, OWNERSHIP, AND LOCATION.

Table 24

TRACK.	1912	1907	1902	PER CENT OF INCREASE.[1] 1902–1912	PER CENT OF INCREASE.[1] 1907–1912	PER CENT OF INCREASE.[1] 1902–1907
Kind.						
Total	41,064.82	34,403.56	22,572.52	81.9	19.4	52.4
Main track	38,333.62	32,485.87	21,681.94	76.8	18.0	49.8
Road or first track	30,437.86	25,547.19	16,651.58	82.8	19.1	53.4
Second (including third, etc.) track	7,895.76	6,938.68	5,030.36	57.0	13.8	37.9
Sidings and turnouts, including track in car barns, storage yards, etc.	2,731.20	1,917.69	907.53	200.9	42.4	111.3
Classification.						
By character of motive power:						
Electric	40,808.39	34,059.69	21,901.53	86.3	19.8	55.5
Electric line transmission	40,704.91	34,034.19	21,899.06	85.9	19.6	55.4
Overhead trolley	38,958.06	32,501.71	21,290.09	83.0	19.9	52.7
Third rail	1,395.13	1,209.78	342.91	306.8	15.3	252.8
Conduit	351.72	322.70	266.06	32.2	9.0	21.3
Gas-electric motors	38.81	22.50	....	....	72.5	....
Storage batteries	64.67	3.00	2.47	....	....	....
Cable	56.41	61.71	240.69	−76.6	−8.6	−74.4
Animal	57.52	136.11	259.10	−77.8	−57.7	−47.5
Steam	76.34	105.06	169.61	−55.0	−27.3	−38.1
Gasoline motors	66.16	40.99	[2] 6.06	....	61.4	....
Classification—Contd.						
By ownership:						
Owned	33,416.86	27,458.97	19,038.98	75.5	21.7	44.2
Leased [3]	7,647.96	6,922.54	3,534.78	116.4	10.5	95.8
Operated under trackage rights	1,284.82	692.28	559.68	129.6	85.6	23.7
From electric railway companies	1,051.19	692.28	559.68	87.8	51.8	23.7
From steam roads [4]	233.63	(5)	(5)	....	....	....
By location:						
(*a*) Surface	40,532.02	33,966.40	22,263.58	82.1	19.3	52.6
Elevated	420.10	366.59	308.94	36.0	14.6	18.7
Subways and tunnels	112.70	70.57	(6)	....	59.7	....
(*b*) On public thoroughfares	26,271.10	23,431.72	18,774.92	39.9	12.1	24.8
On private right of way	14,793.72	10,971.84	3,802.07	289.1	34.8	188.6
(*c*) City and suburban lines	24,699.02	(7)	(7)	....	....	....
Interurban lines	16,365.80	(7)	(7)	....	....	....

[1] A minus sign (−) denotes decrease.
[2] Compressed air.
[3] Includes trackage rights from steam roads.
[4] Included under "Leased."
[5] Figures not available.
[6] Figures not available; included under "Surface."
[7] Reported in 1907 and 1902 as within and without city limits; figures not comparable.

One pair of rails on any thoroughfare constitutes a single main track, and a second pair of rails alongside of the first is a second main track. The length of the second main track, therefore, represents double trackage, except that third and fourth main tracks, in the few places where they occur, are included under second main track.

The length of track that should be regarded as second track rather than sidings and turnouts is left to the judgment of each company. The difference between first main track, or length of road, and second track represents, approximately, the amount of single-track line, although this is not strictly correct, because of the inclusion of third, fourth, etc., main tracks with second main track. The amount of third, etc., main track is relatively small, although figures for the aggregate amount are not available. Ignoring this factor, the length of single track in 1912 was 22,542.10 miles, as compared with 18,608.51 miles in 1907 and 11,621.22 miles in 1902, an increase of 21.1 per cent for the period 1907–1912, 60.1 per cent for the period 1902–1907, and 94 per cent for the decade.

Track operated by electric power.—Electricity was used as the motive power on 40,808.39 miles of street and electric railway track in 1912, or 99.4 per cent of the total mileage for that year. In 1902 there were 675.46 miles of track operated by nonelectric power, while in 1912 there were but 256.43 miles, but little more than one-third of the amount reported at the former census. All classes of nonelectric power show a rapid decrease, with the exception of gasoline motors. There was no trackage operated by this class of power in 1902, but there were 40.99 miles in 1907 and 66.16 in 1912.

Table 25 shows the percentages of the total trackage operated by the several kinds of motive power in use in 1912, 1907, and 1902.

Table 25

TRACK.	TRACK MILEAGE—PER CENT OF TOTAL (BASED ON TABLE 24).		
	1912	1907	1902
Kind.			
Total	100.0	100.0	100.0
Main track	93.3	94.4	96.1
Road or first track	74.1	74.3	73.8
Second (including third, etc.) track	19.2	20.2	22.3
Sidings and turnouts, including track in car barns, storage yards, etc	6.7	5.6	4.0
Classification.			
By character of motive power:			
Electric	99.4	99.0	97.0
Electric line transmission	99.1	98.9	97.0
Overhead trolley	94.9	94.5	94.3
Third rail	3.4	3.5	1.5
Conduit	0.9	0.9	1.2
Gas-electric motors	(1)	(1)	
Storage batteries	0.2	(1)	(1)
Cable	0.1	0.2	1.1
Animal	0.1	0.4	1.1
Steam	0.2	0.3	0.8
Gasoline motors	0.2	0.1	(1)
By ownership:			
Owned	81.4	79.8	84.3
Leased	18.6	20.1	15.7
Operated under trackage rights	3.1	2.0	2.5
From electric railway companies	2.5	2.0	2.5
From steam roads	0.6		
By location:			
(*a*) Surface	98.7	98.7	98.6
Elevated	1.0	1.1	1.4
Subways and tunnels	0.3	0.2	
(*b*) On public thoroughfares	64.0	68.1	83.2
On private right of way	36.0	31.9	16.8
(*c*) City and suburban lines	60.1		
Interurban lines	39.9		

[1] Less than one-tenth of 1 per cent.

Table 26 shows comparative statistics for track operated by the different electric systems, for 1912, 1907, and 1902.

Table 26

KIND OF SYSTEM.	ELECTRIC TRACK—NUMBER OF COMPANIES AND MILES OF TRACK, BY KIND OF SYSTEM.					
	1912	1907	1902	Per cent of increase.		
				1902–1912	1907–1912	1902–1907
Number of operating companies reporting electric track	942	904	747	26.1	4.2	21.0
Overhead trolley	926	895	736	25.8	3.5	21.6
Third rail	25	23	11			
Conduit	13	10	11			
Storage batteries	10	1	2			
Gas-electric motors	1	1				
Miles of electric track	40,808.39	34,059.69	21,901.53	86.3	19.8	55.5
Overhead trolley	38,958.06	32,501.71	21,290.09	83.0	19.9	52.7
Third rail	1,395.13	1,029.78	342.91	306.8	35.5	200.3
Conduit	351.72	322.70	266.06	32.2	9.0	21.3
Storage batteries	[1] 64.67	3.00	2.47			
Gas-electric motors	38.81	22.50				
Per cent of total electric track:						
Overhead trolley	95.5	95.4	97.2			
Third rail	3.3	3.6	1.6			
Conduit	0.9	0.9	1.2			
Storage batteries	0.2	(2)	(2)			
Gas-electric motors	0.1	0.1				

[1] Includes 2.44 miles which is also operated with gasoline motors.
[2] Less than one-tenth of 1 per cent.

Overhead trolley.—The proportion of electric trackage operated by overhead trolley was slightly less in 1912 and 1907 than in 1902, although it was practically in universal use during the three census periods. The miles of electric track operated by overhead trolley increased from 21,290.09 in 1902 to 38,958.06 in 1912, a gain of 83 per cent. It formed 97.2 per cent of the total trackage in 1902 and 95.5 per cent in 1912.

The number of companies and the miles of electric track other than overhead trolley are shown, by states, for 1912, 1907, and 1902, in Table 27.

Table 27

KIND AND STATE.	ELECTRIC SYSTEMS, OTHER THAN OVERHEAD TROLLEY.					
	Number of companies.			Miles of single track.		
	1912	1907	1902	1912	1907	1902
Third rail.						
United States	25	23	11	1,395.13	1,209.78	342.91
California	3	2		194.79	114.70	
Connecticut			1			25.89
Illinois	5	5	4	253.33	213.44	108.76
Massachusetts	1	1	2	33.96	19.19	41.45
Michigan	2	2	1	138.58	81.13	36.63
New Jersey [1]	1	2		9.56	132.45	
New York	7	5	3	496.66	415.86	130.18
Ohio	1	1		71.18	71.10	
Pennsylvania	4	4		134.06	115.50	
Washington	1	1		63.01	50.41	
Conduit.						
United States	13	10	11	351.72	322.70	266.06
District of Columbia	7	7	6	115.18	96.14	86.88
New York	6	3	4	236.54	226.56	178.89
Michigan			1			0.29
Storage batteries.						
United States	10	1	2	64.67	3.00	2.47
Delaware	1			10.80		
District of Columbia	1			[2] 2.44		
Illinois		1	1		3.00	1.50
Maryland	1			3.16		
New York	4		1	28.17		0.97
Pennsylvania	2			17.10		
South Carolina	1			3.00		
Gas-electric motors.						
United States	1	1		38.81	22.50	
Kansas		1			22.50	
Minnesota	1			38.81		

[1] One company with 130.95 miles of track in 1907, reported as an electric road, classified as an electrified division of a steam road in 1912.
[2] Also operated by gasoline motors.

Third rail.—The third-rail system, being limited to elevated structures, subways, and tunnels, and to tracks on private right of way, is still of minor importance. The trackage operated under this system, however, was more than four times as great in 1912 as in 1902.

Conduit.—The conduit system (sometimes referred to as "conduit trolley") is the most expensive type of electric traction construction, and is in use only where municipal regulations prohibit the use of overhead trolleys. The 13 companies reporting this system in 1912 were confined to New York City and the District of Columbia. Their trackage increased from 266.06 miles in 1902 to 351.72 miles in 1912, a gain of 32.2 per cent.

Storage batteries.—In 1907 there was but one road, with 3 miles of track, operated by storage batteries. In 1912, 10 companies reported the use of storage batteries, and the miles of track had increased to 64.67, practically all of which was in New York, Pennsylvania, and Delaware.

Gas-electric motors.—The term refers to the electric motor system in which the car carries an electric generating set and is independent of outside power. The equipment consists of an internal-combustion engine, a dynamo, a storage battery, and the car motors. The storage battery absorbs the charge during the periods of rest or light load and supplements the dynamo at times of heavy power consumption.

Table 28 gives the miles of track, classified as "Electric" and "All other," by geographic divisions and states, together with the miles of track within each division and state, for 1912, 1907, and 1902.

STREET AND ELECTRIC RAILWAYS—NUMBER OF OPERATING COMPANIES AND MILES OF TRACK OPERATED: 1912, 1907, AND 1902.

Table 28

DIVISION AND STATE.	Census.	Number of operating companies.	MILES OF TRACK OPERATED BY COMPANIES IN DIVISION OR STATE: 1912, 1907, AND 1902.			Miles of track in division or state.
			Total.	Electric.	All other.	
UNITED STATES	1912	975	[1] 41,064.82	[2] 40,811.49	253.33	41,032.91
	1907	945	34,381.51	34,037.64	343.87	34,353.99
	1902	817	22,572.52	21,897.06	675.46	22,568.32
GEOGRAPHIC DIVISIONS:						
New England	1912	91	[3] 5,294.55	5,280.01	14.54	5,299.02
	1907	121	4,874.04	4,870.61	3.43	4,862.93
	1902	141	4,008.32	4,005.32	3.00	4,013.52
Middle Atlantic	1912	246	[4] 10,043.03	9,993.81	49.52	10,064.31
	1907	249	8,829.98	8,714.80	115.18	8,891.06
	1902	220	6,152.10	5,917.52	234.58	6,168.14
East North Central.	1912	222	11,809.69	11,764.76	44.93	11,883.69
	1907	220	10,335.97	10,251.02	84.95	10,353.18
	1902	181	6,074.60	5,962.57	112.03	6,148.88
West North Central.	1912	85	3,098.62	3,089.71	8.91	3,030.50
	1907	73	2,508.36	2,459.85	48.51	2,454.61
	1902	60	1,740.72	1,671.26	69.46	1,688.67
South Atlantic	1912	107	2,962.28	[2] 2,922.09	40.19	2,899.75
	1907	101	2,294.23	2,285.95	8.28	2,244.46
	1902	80	1,670.15	1,656.47	13.68	1,628.90
East South Central.	1912	45	1,287.26	1,285.41	1.85	1,290.68
	1907	40	1,064.69	1,052.81	11.88	1,074.75
	1902	34	768.17	731.34	36.83	762.90
West South Central.	1912	79	[5] 1,376.23	1,363.05	13.18	1,371.80
	1907	50	841.22	831.19	10.03	839.98
	1902	32	554.28	539.09	15.19	553.13
Mountain	1912	40	1,007.32	1,001.19	6.13	1,047.52
	1907	28	601.39	601.39	....	630.24
	1902	20	409.48	401.03	8.45	409.48
Pacific	1912	60	4,185.84	4,111.46	74.38	4,145.64
	1907	63	3,031.63	2,970.02	61.61	3,002.78
	1902	49	1,194.70	1,012.46	182.24	1,194.70
NEW ENGLAND:						
Maine	1912	16	[3] 536.38	533.28	3.10	530.49
	1907	17	424.06	421.06	3.00	418.12
	1902	19	331.55	328.55	3.00	328.50
New Hampshire	1912	13	246.26	246.26	....	268.15
	1907	16	247.10	247.10	....	268.38
	1902	7	167.65	167.65	....	174.45
Vermont	1912	9	102.85	102.85	....	120.83
	1907	10	124.31	124.31	....	113.38
	1902	9	80.55	80.55	....	86.05
Massachusetts	1912	43	3,010.48	3,009.28	1.20	2,950.96
	1907	63	2,877.50	2,877.07	0.43	2,851.11
	1902	75	2,521.18	2,521.18	....	2,503.11
Rhode Island	1912	2	395.71	385.47	10.24	435.37
	1907	6	419.92	419.92	....	430.76
	1902	8	328.90	328.90	....	342.92
Connecticut	1912	8	1,002.87	1,002.87	....	993.22
	1907	9	781.15	781.15	....	781.18
	1902	23	578.49	578.49	....	578.49
MIDDLE ATLANTIC:						
New York	1912	101	[4] 4,605.44	4,566.55	38.89	4,485.81
	1907	101	3,884.74	3,788.24	96.50	3,809.19
	1902	96	2,809.91	2,590.16	219.75	2,797.90
New Jersey	1912	24	1,319.85	1,319.85	....	1,308.97
	1907	26	1,324.12	1,324.12	....	1,319.80
	1902	26	861.28	858.66	2.62	865.66
Pennsylvania	1912	121	4,117.74	4,107.41	10.33	4,269.53
	1907	122	3,621.12	3,602.44	18.68	3,762.07
	1902	98	2,480.91	2,468.70	12.21	2,504.58
EAST NORTH CENTRAL:						
Ohio	1912	75	4,069.12	4,067.06	2.06	3,999.22
	1907	73	3,762.69	3,718.63	44.06	3,671.45
	1902	63	2,353.43	2,351.32	2.11	2,338.50
Indiana	1912	34	2,301.34	2,298.27	3.07	2,323.38
	1907	33	1,932.93	1,928.68	4.25	1,928.78
	1902	27	646.66	643.87	2.79	656.63
Illinois	1912	67	3,125.84	3,086.04	39.80	3,185.73
	1907	70	2,774.67	2,738.03	36.64	2,753.71
	1902	50	1,635.20	1,528.07	107.13	1,659.35
Michigan	1912	22	1,507.26	1,507.26	....	1,526.25
	1907	24	1,275.03	1,275.03	....	1,323.71
	1902	24	1,022.81	1,022.81	....	1,048.26
Wisconsin	1912	24	806.13	806.13	....	849.11
	1907	20	590.65	590.65	....	675.53
	1902	17	416.50	416.50	....	446.14
WEST NORTH CENTRAL:						
Minnesota	1912	9	555.18	552.55	2.63	538.48
	1907	5	457.15	456.02	1.13	437.82
	1902	5	338.17	338.17	....	316.27
Iowa	1912	24	803.87	803.87	....	783.87
	1907	24	639.84	619.45	20.39	641.39
	1902	22	378.25	374.43	3.82	341.35
Missouri	1912	19	996.00	993.53	2.47	959.01
	1907	14	921.67	919.20	2.47	866.68
	1902	16	758.38	719.48	38.90	713.68
North Dakota	1912	3	26.02	26.02	....	19.18
	1907	4	16.09	16.09	....	13.66
South Dakota	1912	2	21.59	21.59	....	21.59
	1907	1	5.00	5.00	....	5.00
	1902	1	2.00	....	2.00	2.00
Nebraska	1912	7	243.80	242.00	1.80	214.46
	1907	8	218.73	211.01	7.72	184.34
	1902	4	113.66	110.55	3.11	119.56
Kansas	1912	21	452.16	450.15	2.01	493.91
	1907	17	249.88	233.08	16.80	305.72
	1902	12	150.26	128.63	21.63	195.81
SOUTH ATLANTIC:						
Delaware	1912	4	90.37	90.37	....	99.37
	1907	4	95.93	95.93	....	104.93
	1902	3	85.61	85.61	....	85.61
Maryland	1912	14	692.51	685.68	6.83	719.74
	1907	13	536.18	536.18	....	551.51
	1902	10	437.84	437.84	....	455.44
District of Columbia.	1912	7	214.23	[2] 214.23	....	188.46
	1907	6	176.03	176.03	....	160.02
	1902	8	161.97	161.97	....	146.17
Virginia	1912	18	561.86	554.88	6.98	561.49
	1907	23	515.54	515.54	....	512.99
	1902	21	359.30	357.30	2.00	358.17
West Virginia	1912	21	404.98	404.98	....	330.18
	1907	15	265.41	265.41	....	207.72
	1902	8	140.00	140.00	....	93.08
North Carolina	1912	13	190.26	188.23	2.03	190.26
	1907	11	106.44	103.69	2.75	106.44
	1902	7	46.32	46.32	....	46.32
South Carolina	1912	6	202.60	202.60	....	228.08
	1907	7	131.26	129.76	1.50	131.18
	1902	7	76.98	73.80	3.18	76.98
Georgia	1912	14	440.63	428.53	12.10	417.33
	1907	12	349.18	346.28	2.90	351.41
	1902	10	300.38	296.63	3.75	305.38
Florida	1912	10	164.84	152.59	12.25	164.84
	1907	10	118.26	117.13	1.13	118.26
	1902	6	61.75	57.00	4.75	61.75

[1] Includes 31.91 miles of track lying outside of the United States.
[2] Includes 2.44 miles operated by storage battery and gasoline motor.
[3] Includes 3 miles of track in Canada.
[4] Includes 24.48 miles of track in Canada.
[5] Includes 4.43 miles of track in Mexico.

STREET AND ELECTRIC RAILWAYS—NUMBER OF OPERATING COMPANIES AND MILES OF TRACK OPERATED: 1912, 1907, AND 1902—Continued.

Table 28—Contd.

DIVISION AND STATE.	Census.	Number of operating companies.	MILES OF TRACK OPERATED BY COMPANIES IN DIVISION OR STATE: 1912, 1907, AND 1902.			Miles of track in division or state.
			Total.	Electric.	All other.	
EAST SOUTH CENTRAL:						
Kentucky	1912	10	493.21	493.21	....	502.38
	1907	13	389.13	389.13	....	402.34
	1902	12	283.95	283.95	....	284.35
Tennessee	1912	12	370.28	369.31	0.97	360.93
	1907	9	297.50	296.62	0.88	292.15
	1902	8	254.20	248.40	5.80	248.53
Alabama	1912	11	306.63	306.63	....	308.80
	1907	10	291.66	280.66	11.00	293.86
	1902	9	204.72	173.69	31.03	204.72
Mississippi	1912	12	117.14	116.26	0.88	118.57
	1907	8	86.40	86.40	....	86.40
	1902	5	25.30	25.30	....	25.30
WEST SOUTH CENTRAL:						
Arkansas	1912	10	122.92	121.94	0.98	113.72
	1907	8	87.39	86.41	0.98	82.22
	1902	7	52.49	49.83	2.66	51.33
Louisiana	1912	13	285.10	285.10	....	285.10
	1907	11	238.52	238.52	....	238.52
	1902	8	198.52	192.86	5.66	198.52
Oklahoma	1912	17	251.56	251.56	....	251.56
	1907	8	100.44	100.44	....	100.44
Texas	1912	39	[1] 716.65	704.45	12.20	721.42
	1907	23	414.87	405.82	9.05	418.80
	1902	17	303.27	296.40	6.87	303.28
MOUNTAIN:						
Montana	1912	6	99.22	99.22	....	99.22
	1907	5	69.24	69.24	....	69.24
	1902	5	63.21	63.21	....	63.21
Colorado	1912	16	467.97	467.97	....	467.97
	1907	11	317.37	317.37	....	317.37
	1902	8	234.53	233.28	1.25	234.53
MOUNTAIN—Contd.						
New Mexico	1912	2	10.60	10.60	....	10.60
	1907	2	10.10	10.10	....	10.10
	1902	1	2.10	....	2.10	2.10
Arizona	1912	4	46.24	46.24	....	46.24
	1907	4	30.75	30.75	....	30.75
	1902	2	17.10	12.00	5.10	17.10
Idaho	1912	3	88.93	88.93	....	129.13
	1907	2	44.24	44.24	....	73.09
	1902	1	3.50	3.50	....	3.50
Wyoming	1912	2	22.91	22.91	....	22.91
Nevada	1912	2	11.27	11.27	....	11.27
	1907	1	7.15	7.15	....	7.15
Utah	1912	5	260.18	254.05	6.13	260.18
	1907	3	122.54	122.54	....	122.54
	1902	3	89.04	89.04	....	89.04
PACIFIC:						
Washington	1912	19	1,035.92	1,026.31	9.61	991.17
	1907	14	764.73	743.64	21.09	730.27
	1902	8	228.93	214.33	14.60	228.93
Oregon	1912	6	544.64	521.03	23.61	549.19
	1907	8	253.41	252.39	1.02	259.02
	1902	6	136.67	132.17	4.50	136.67
California	1912	35	2,605.28	2,564.12	41.16	2,605.28
	1907	41	2,013.49	1,973.99	39.50	2,013.49
	1902	35	829.10	665.96	163.14	829.10

[1] Includes 4.43 miles of track in Mexico.

Interstate trackage.—The term "miles of track operated" refers to the operated trackage of the companies credited to the respective geographic divisions and states. The miles of track in a state or division excludes trackage outside of the state or division but owned by companies within it, and includes trackage within the state or division but owned by outside companies. The differences between totals for the United States represent trackage lying outside of the United States.

Table 29 shows the actual trackage in each state and the statistics in detail for interstate trackage for 1912.

It will be seen that certain states do not receive credit for the operation of considerable trackage located within them, notably New Hampshire, Vermont, Rhode Island, Pennsylvania, Maryland, South Carolina, and Idaho; and on the other hand, the statistics for certain other states are inflated by outside business, the states chiefly profiting being Massachusetts, New York, Ohio, Missouri, Nebraska, District of Columbia, West Virginia, Georgia, and Washington. Diagram 1 (p. 192) shows the net trackage graphically by states.

The track lying outside of the United States but operated by companies for which statistics were included in the reports for the respective censuses is shown in the following tabular statement:

COUNTRY OR PROVINCE.	MILES OF TRACK LYING OUTSIDE OF THE UNITED STATES.		
	1912	1907	1902
Total	31.91	27.52	4.20
In Dominion of Canada	27.48	26.28	3.05
Ontario, operated by a company in New York	24.48	23.23	....
New Brunswick, operated by a company in Maine	3.00	3.05	3.05
In Mexico, operated by a company in Texas	4.43	1.24	1.15

STREET AND ELECTRIC RAILWAYS—MILES OF TRACK OPERATED: 1912.

Table 29

STATE.	Net total in state.	Reported by companies in state.	LOCATED OUTSIDE OF STATE, OPERATED BY COMPANIES IN STATE.		LOCATED WITHIN STATE, OPERATED BY COMPANIES OUTSIDE OF STATE.	
			Total.	States and miles of track.	Total.	States and miles of track.
UNITED STATES	41,032.91	41,064.82	31.91	Canada, 27.48; Mexico, 4.43	......	
NEW ENGLAND:						
Maine	530.49	536.38	5.89	N. H., 2.89; Canada, 3	......	
New Hampshire	268.15	246.26	......		21.89	Me., 2.89; Vt., 2.87; Mass., 16.13.
Vermont	120.83	102.85	2.87	N. H., 2.87	20.85	Mass., 20.85.
Massachusetts	2,950.96	3,010.48	59.52	N. H., 16.13; R. I., 22.54; Vt., 20.85	......	
Rhode Island	435.37	395.71	1.95	Conn., 1.95	41.61	Mass., 22.54; Conn., 19.07.
Connecticut	993.22	1,002.87	19.07	R. I., 19.07	9.42	R. I., 1.95; N. Y., 7.47.
MIDDLE ATLANTIC:						
New York	4,485.81	4,605.44	133.12	Conn., 7.47; N. J., 11.68; Pa., 89.49; Canada, 34.48.	13.49	Pa., 13.49.
New Jersey	1,308.97	1,319.85	22.56	Pa., 22.56	11.68	N. Y., 11.68.
Pennsylvania	4,269.53	4,117.74	25.74	Md., 1.25; Ohio, 2; N. Y., 13.49; Del., 9	173.03	N. Y., 89.49; N. J., 22.56; Ohio, 60.98.
EAST NORTH CENTRAL:						
Ohio	3,999.22	4,069.12	141.70	Ind., 43.31; Mich., 37.41; Pa., 60.98	71.80	Pa., 2; Mich., 2.84; W. Va., 65.96; Ky., 1.
Indiana	2,323.38	2,301.34	26.32	Ill., 24.22; Ky., 2.10	48.36	Ohio, 43.31; Mich., 5.05.
Illinois	3,185.73	3,125.84	20.15	Mo., 4.76; Wis., 15.39	80.04	Ind., 24.22; Wis., 6.48; Iowa, 49.34.
Michigan	1,526.25	1,507.26	18.42	Ohio, 2.84; Ind., 5.05; Wis., 10.53	37.41	Ohio, 37.41.
Wisconsin	849.11	806.13	6.48	Ill., 6.48	49.46	Ill., 15.39; Mich., 10.53; Minn. 23.54.
WEST NORTH CENTRAL:						
Minnesota	538.48	555.18	23.97	Wis., 23.54; N. Dak., 0.43	7.27	N. Dak., 7.27.
Iowa	783.87	803.87	49.34	Ill., 49.34	29.34	Nebr., 29.34.
Missouri	959.01	996.00	64.22	Kans., 64.22	27.23	Ill., 4.76; Kans., 22.47.
North Dakota	19.18	26.02	7.27	Minn., 7.27	0.43	Minn., 0.43.
South Dakota	21.59	21.59	......		......	
Nebraska	214.46	243.80	29.34	Iowa, 29.34	......	
Kansas	493.91	452.16	22.47	Mo., 22.47	64.22	Mo., 64.22.
SOUTH ATLANTIC:						
Delaware	99.37	90.37	......		9.00	Pa., 9.
District of Columbia	188.46	214.23	30.48	Md., 30.48	4.71	Va., 4.71.
Maryland	719.74	692.51	4.50	Pa., 4.50	31.73	Pa., 1.25; D. C., 30.48.
Virginia	561.49	561.86	4.71	D. C., 4.71	4.34	W. Va., 0.77; Tenn., 3.57.
West Virginia	330.18	404.98	74.80	Ohio, 65.96; Ky., 8.07; Va., 0.77	......	
North Carolina	190.26	190.26	......		......	
South Carolina	228.08	202.60	......		25.48	Ga., 25.48.
Georgia	417.33	440.63	27.65	Ala., 2.17; S. C., 25.48	4.35	Tenn., 4.35.
Florida	164.84	164.84	......		......	
EAST SOUTH CENTRAL:						
Kentucky	502.38	493.21	1.00	Ohio, 1	10.17	Ind., 2.10; W. Va., 8.07.
Tennessee	360.93	370.28	9.35	Ga., 4.35; Va., 3.57; Miss., 1.43	......	
Alabama	308.80	306.63	......		2.17	Ga., 2.17.
Mississippi	118.57	117.14	......		1.43	Tenn., 1.43.
WEST SOUTH CENTRAL:						
Arkansas	113.72	122.92	9.20	Tex., 9.20	......	
Louisiana	285.10	285.10	......		......	
Oklahoma	251.56	251.56	......		......	
Texas	721.42	716.65	4.43	Mexico, 4.43	9.20	Ark., 9.20.
MOUNTAIN:						
Montana	99.22	99.22	......		......	
Colorado	467.97	467.97	......		......	
New Mexico	10.60	10.60	......		......	
Arizona	46.24	46.24	......		......	
Idaho	129.13	88.93	......		40.20	Wash., 40.20.
Wyoming	22.91	22.91	......		......	
Nevada	11.27	11.27	......		......	
Utah	260.18	260.18	......		......	
PACIFIC:						
Washington	991.17	1,035.92	44.75	Idaho, 40.20; Oreg., 4.55	......	
Oregon	549.19	544.64	......		4.55	Wash., 4.55.
California	2,605.28	2,605.28	......		......	

Electrified trackage of all companies and systems.—In addition to the 41,064.82 miles of track operated by the street and electric railways in 1912, there were 1,409.15 miles of single track operated by roads outside of the classified industry, this supplemental trackage comprising 1,284.11 miles operated by the electrified divisions of steam roads, 63.04 miles of electrified trackage through tunnels on steam roads, and 62 miles of narrow-gauge track (2-foot gauge) of the tunnel companies operated by the Chicago Tunnel Co., which does a merchandise and freight business in tunnels under the streets of Chicago, and the Bingham Central Railway Co. of Utah, which does an ore-haulage business.

The 1,284.11 miles operated by the electrified divisions of steam roads comprises 1,184.49 miles of electric trackage and 99.62 miles of exclusively steam trackage. Of the 313.60 miles of steam trackage, 213.98 miles was reported by companies operating both steam and electric trains, so that of the 1,284.11 miles reported by the electrified divisions of steam roads, 970.51 was operated by electricity exclusively, 213.98 was used by both steam and electric trains, and 99.62 by steam trains only.

Table 30 gives the track statistics for all companies and systems and shows the total electrified trackage of the country, by states, for all states where there is electrified trackage other than that reported for street and electric railways.

Table 30 MILES OF TRACK—ELECTRIFIED TRACKAGE OF ALL CLASSES OF COMPANIES AND SYSTEMS, BY STATES: 1912.

KIND AND STATE.	Total.	Street and electric railways.	Tunnel companies not included with street and electric railways.	Steam railroads.	
				Electrified divisions.	Electric tunnel haulage.
Number of operating companies	1,000	975	2	18	5
Miles of single track	42,473.97	41,064.82	62.00	1,284.11	63.04
Electric	42,117.92	40,808.39	62.00	1,184.49	63.04
Overhead trolley	39,724.53	38,958.06	62.00	669.33	35.14
Third rail	1,938.19	1,395.13		515.16	27.90
Other electric	455.20	455.20			
Steam	[1] 389.94	76.34		[1] 313.60	
Cable, animal, and gasoline motor	180.09	180.09			
Electric.					
California	2,714.42	2,564.12		150.30	
Overhead trolley	2,486.51	2,369.33		117.18	
Third rail	227.91	194.79		33.12	
New Jersey	1,470.22	1,319.85		150.37	
Overhead trolley	1,318.94	1,310.29		8.65	
Third rail	151.28	9.56		141.72	
New York	5,181.71	4,563.45		618.26	
Overhead trolley	4,080.02	3,802.08		277.94	
Third rail	836.98	496.66		340.32	
Other electric	264.71	264.71			
All other states	32,751.57	32,360.97	62.00	265.56	63.04
Overhead trolley	31,839.06	31,476.36	62.00	265.56	35.14
Third rail	722.02	694.12			27.90
Other electric	190.49	190.49			
Overhead trolley.					
California	2,486.51	2,369.33		117.18	
Illinois	2,994.69	2,832.71	58.00	103.98	
Maryland	683.54	682.52			1.02
Massachusetts	3,013.97	2,975.32		16.78	21.87
Michigan	1,370.93	1,368.68			2.25
Montana	122.60	99.22		23.38	
New Jersey	1,318.94	1,310.29		8.65	
New York	4,080.02	3,802.08		277.94	
Ohio	4,010.08	3,995.88		14.20	
Rhode Island	423.93	385.47		38.46	
South Dakota	26.08	21.59		4.49	
Utah	258.05	254.05	4.00		
Virginia	615.82	551.55		64.27	
Washington	973.30	963.30			10.00
All other states	17,346.07	17,346.07			
Third rail.					
California	227.91	194.79		33.12	
New Jersey	151.28	9.56		141.72	
New York	836.98	496.66		340.32	
All other states	722.02	694.12			27.90

[1] Includes 213.98 miles of duplicated track.

Power other than electricity.—Table 31 shows the number of companies using motive power other than electricity and the number using such power exclusively, with miles of track operated by each kind of power, for 1912, 1907, and 1902.

The 21 companies employing cable traction in 1912 include 7 in California, 5 in Pennsylvania, 2 each in Minnesota and Washington, and 1 each in Mississippi, Missouri, Ohio, Tennessee, and Virginia. The 13 companies using animal power include 3 in New York, 3 in Texas, and 1 each in Arkansas, Indiana, Kansas, Maine, Mississippi, Nebraska, and Ohio.

Steam trackage operated by street and electric railways was reported by 9 companies, 1 each in 9 states, and gasoline motor trackage was reported by 2 companies each in Georgia, California, and Texas, and by 1 each in Florida, Illinois, and Massachusetts,

Table 31 NUMBER OF COMPANIES USING POWER OTHER THAN ELECTRIC, AND MILES OF TRACK OPERATED.

KIND OF POWER.	1912	1907	1902	Per cent of increase.[1]		
				1902–1912	1907–1912	1902–1907
Number of companies using—						
Cable	[2]21	20	26	−19.2	5.0	−23.1
Animal	[2]13	28	67	−80.6	−53.6	−58.2
Steam	9	12	12	−25.0	−25.0	
Gasoline motors	9	5	[3] 1		80.0	
Number of companies (included above) operating exclusively by—						
Cable	13	10	12	8.3	30.0	−16.7
Animal	9	23	53	−83.0	−60.9	−56.6
Steam	1	3	3	−66.7	−66.7	
Gasoline motors	8	5	[3] 1		60.0	
Miles of track	256.43	343.87	675.46	−62.0	−25.4	−40.9
Cable	56.41	61.71	240.69	−76.6	− 8.6	−74.4
Animal	57.52	136.11	259.10	−79.0	−60.0	−47.5
Steam	76.34	105.06	169.61	−55.0	−27.6	−38.1
Gasoline motors	66.16	40.99	[3] 6.06		61.4	

[1] A minus sign (—) denotes decrease.

[2] One company part cable and part animal.

[3] Compressed air.

Elevated and subway trackage.—The elevated and subway or tunnel trackage in 1912 aggregated 532.80 miles, as compared with 437.16 miles in 1907, and the surface trackage amounted to 40,532.02 miles in 1912, as compared with 33,966.40 miles in 1907. The proportionate increases in nonsurface and surface trackage were substantially the same, namely, 21.9 per cent for nonsurface (elevated and subway and tunnel) and 19.3 per cent for surface. In 1902 tracks in subways and tunnels were not reported separately, but the mileage of track on elevated structures aggregated 308.94.

Table 32 shows the miles of single track located on elevated structures, and in subways and tunnels, for 1912, 1907, and 1902.

Table 32 ELEVATED AND SUBWAY AND TUNNEL TRACKAGE, BY STATES.

STATE.	Miles of single track.			Per cent of increase.		
	1912	1907	1902	1902–1912	1907–1912	1902–1907
Elevated.						
United States	420.10	362.39	308.94	36.0	15.9	17.3
Illinois	144.20	125.77	107.96	33.2	14.6	16.5
Maryland	1.40	1.40				
Massachusetts	26.58	16.70	16.02	65.9	59.0	4.2
Missouri	2.88	3.18				
New Jersey	4.37	[1] 7.26				
New York	230.80	200.41	184.96	24.8	15.2	8.4
Pennsylvania	9.87	7.67			28.7	
Subway and tunnel.						
United States	112.70	74.77	([2])		50.7	
Illinois	1.87	0.60				
Massachusetts	18.45	7.75			138.1	
New Jersey	11.68					
New York	70.54	60.38			16.8	
Pennsylvania	8.42	5.62			49.8	
All other states [3]	1.74	0.42				

[1] Includes 3.06 miles of Camden & Atlantic Branch of West Jersey & Seashore Railroad Co., tabulated as an electrified division of a steam road in 1912.

[2] Figures not available.

[3] Includes: 1912—California, Kansas, Missouri, Oregon, and Tennessee; 1907—Missouri.

The elevated and subway tracks of Illinois, Massachusetts, New York, and Pennsylvania represent the districts of Chicago, Boston, New York City, and Philadelphia, respectively. The 11.68 miles of subway and tunnel trackage of New Jersey is the portion of the Hudson & Manhattan system extending into that state, which in other tables is credited to New York, to which latter state the system as a unit is credited. The subway and tunnel trackage reported in the group of "All other states" no doubt represents track in under-crossings of steam railroad lines, not properly subways or tunnels, although so reported.

Elevated trackage was reported by 13 companies in 1912, distributed as follows: Illinois, 4; New York, 4; and 1 each in Maryland, Massachusetts, Missouri, New Jersey, and Pennsylvania. Subway and tunnel trackage was reported by 14 companies, located, 4 in New York (1 of which extends into New Jersey), 2 in Massachusetts, 2 in Pennsylvania, and 1 each in California, Illinois, Kansas, Missouri, Oregon, and Tennessee.

Ownership of track.—The track statistics, as reported by the operating companies, show the track owned by the companies, the track leased, and that operated under trackage rights. The trackage reported by the lessor street and electric railway companies is included in the leased track reported by the operating companies. This leased trackage includes not only the track of lessor street and electric railway companies, but all track leased from steam railroads, bridge companies, municipalities, etc., and also trackage rights over steam roads. In 1912, of the 41,064.82 miles of track operated, 33,416.86 miles, or 81.4 per cent, was owned by the operating companies and 7,647.96 miles, or 18.6 per cent, was leased, this leased trackage comprising 6,998.56 of operated track owned by lessor street and electric railway companies, 415.77 miles of track leased from steam roads, bridge companies, manufacturing corporations, and municipalities owning bridges, and 233.63 miles of trackage rights from steam roads. The statistics for this subdivision of trackage are given for 1912, 1907, and 1902 in Table 33.

STREET AND ELECTRIC RAILWAYS—MILES OF TRACK OWNED AND LEASED BY OPERATING COMPANIES: 1912, 1907, AND 1902.

Table 33

DIVISION AND STATE.	Census.	Total.	Owned.	Leased.	PER CENT OF TOTAL.	
					Owned.	Leased.
UNITED STATES...	1912	41,064.82	33,416.86	7,647.96	81.4	18.6
	1907	34,403.56	27,480.65	6,922.91	79.9	20.1
	1902	22,576.99	19,025.85	3,551.14	84.3	15.7
GEOGRAPHIC DIVISIONS:						
New England.....	1912	5,294.55	3,957.04	1,337.51	74.7	25.3
	1907	4,883.39	3,845.66	1,037.73	78.7	21.3
	1902	4,012.79	3,432.43	580.36	85.5	14.5
Middle Atlantic...	1912	10,043.03	6,709.96	3,333.07	66.8	33.2
	1907	8,829.98	5,616.11	3,213.87	63.6	36.4
	1902	6,152.10	4,165.29	1,986.81	67.7	32.3
East North Central.	1912	11,809.69	9,826.45	1,983.24	83.2	16.8
	1907	10,342.17	8,046.39	2,295.78	77.8	22.2
	1902	6,074.60	5,462.75	611.85	89.9	10.1
West North Central.	1912	3,098.62	3,034.81	63.81	97.9	2.1
	1907	2,508.36	2,409.16	99.20	96.0	4.0
	1902	1,740.72	1,379.83	360.89	79.3	20.7
South Atlantic....	1912	2,962.28	2,440.35	521.93	82.4	17.6
	1907	2,300.73	2,186.31	114.42	95.0	5.0
	1902	1,670.15	1,660.47	9.68	99.4	0.6
East South Central.	1912	1,287.26	1,278.41	8.85	99.3	0.7
	1907	1,064.69	1,060.42	4.27	99.6	0.4
	1902	768.17	768.17	....	100.0	....
West South Central.	1912	1,376.23	1,241.18	135.05	90.2	0.8
	1907	841.22	721.94	119.28	85.8	14.2
	1902	554.28	554.28	....	100.0	....
Mountain.........	1912	1,007.32	897.49	109.83	89.1	10.9
	1907	601.39	593.64	7.75	98.7	1.3
	1902	409.48	407.93	1.55	99.6	0.4
Pacific............	1912	4,185.84	4,031.17	154.67	96.3	3.7
	1907	3,031.63	3,001.02	30.61	99.0	1.0
	1902	1,194.70	1,194.70	....	100.0	....
NEW ENGLAND:						
Maine............	1912	536.38	430.01	106.37	80.2	19.8
	1907	424.06	424.06	....	100.0	....
	1902	331.55	328.08	3.47	99.0	1.0
New Hampshire..	1912	246.26	215.54	30.72	87.5	12.5
	1907	247.10	247.10	....	100.0	....
	1902	167.65	111.43	56.22	66.5	33.5
Vermont..........	1912	102.85	102.85	....	100.0	....
	1907	124.31	124.31	....	100.0	....
	1902	80.55	80.55	....	100.0	....
NEW ENGLAND—Con.						
Massachusetts....	1912	3,010.48	2,463.10	547.38	81.8	18.2
	1907	2,886.85	2,339.88	546.97	81.1	18.9
	1902	2,525.65	2,040.41	485.24	80.8	19.2
Rhode Island.....	1912	395.71	54.77	340.94	13.8	86.2
	1907	419.92	146.97	272.95	35.0	65.0
	1902	328.90	328.90	....	100.0	....
Connecticut.......	1912	1,002.87	690.77	312.10	68.9	31.1
	1907	781.15	563.34	217.81	72.1	27.9
	1902	578.49	543.06	35.43	93.9	6.1
MIDDLE ATLANTIC:						
New York........	1912	4,605.44	3,811.34	794.10	82.8	17.2
	1907	3,884.74	2,877.14	1,007.60	74.1	25.9
	1902	2,509.91	2,287.25	522.66	81.4	18.6
New Jersey.......	1912	1,319.85	728.75	581.10	56.0	44.0
	1907	1,324.12	926.99	397.13	70.0	30.0
	1902	861.28	623.37	237.91	72.4	27.6
Pennsylvania.....	1912	4,117.74	2,159.87	1,957.87	52.5	47.5
	1907	3,621.12	1,811.98	1,809.14	50.0	50.0
	1902	2,480.91	1,254.67	1,226.24	50.6	49.4
EAST NORTH CENTRAL:						
Ohio..............	1912	4,069.12	2,946.71	1,122.41	72.4	27.6
	1907	3,767.10	2,718.08	1,049.02	72.2	27.8
	1902	2,353.43	2,101.21	252.22	89.3	10.7
Indiana...........	1912	2,301.34	1,788.82	512.52	77.7	22.3
	1907	1,932.93	1,159.68	773.25	60.0	40.0
	1902	646.66	646.66	....	100.0	....
Illinois...........	1912	3,125.84	3,044.12	81.72	97.4	2.6
	1907	2,776.46	2,302.95	473.51	82.9	17.1
	1902	1,635.20	1,275.57	359.63	78.0	22.0
Michigan.........	1912	1,507.26	1,248.67	258.59	82.8	17.2
	1907	1,275.03	1,275.03	....	100.0	....
	1902	1,022.81	1,022.88	....	100.0	....
Wisconsin........	1912	806.13	798.13	8.00	99.0	1.0
	1907	590.65	590.65	....	100.0	....
	1902	416.50	416.50	....	100.0	....
WEST NORTH CENTRAL:						
Minnesota........	1912	555.18	544.35	10.83	98.0	2.0
	1907	457.15	457.15	....	100.0	....
	1902	338.17	338.17	....	100.0	....
Iowa.............	1912	803.87	788.25	15.62	98.1	1.9
	1907	639.84	578.62	61.22	90.4	9.6
	1902	378.25	378.25	....	100.0	....

STREET AND ELECTRIC RAILWAYS—MILES OF TRACK OWNED AND LEASED BY OPERATING COMPANIES: 1912, 1907, AND 1902—Continued.

Table 33—Contd. DIVISION AND STATE.	Census.	Total.	Owned.	Leased.	PER CENT OF TOTAL.	
					Owned.	Leased.
WEST NORTH CENTRAL—Continued.						
Missouri	1912	996.00	993.51	2.49	99.8	0.2
	1907	921.67	917.07	4.60	99.5	0.5
	1902	758.38	397.49	360.89	52.4	47.6
Nebraska	1912	243.80	210.10	33.70	86.2	13.8
	1907	218.73	186.35	32.35	85.2	14.8
	1902	113.66	113.66	....	100.0	....
Kansas	1912	452.16	450.99	1.17	99.7	0.3
	1907	249.88	248.88	1.00	99.6	0.4
	1902	150.26	150.26	....	100.0	....
North and South Dakota.	1912	47.61	47.61	....	100.0	....
	1907	21.09	21.09	....	100.0	....
	1902	2.00	2.00	....	100.0	....
SOUTH ATLANTIC:						
Delaware	1912	90.37	46.30	44.07	51.2	48.8
	1907	95.93	84.32	11.61	87.9	12.1
	1902	85.61	85.61	....	100.0	....
Maryland	1912	692.51	643.13	49.38	92.9	7.1
	1907	536.18	525.76	10.42	98.1	1.9
	1902	437.84	431.92	5.92	98.6	1.4
District of Columbia.	1912	214.23	214.23	....	100.0	....
	1907	176.03	176.03	....	100.0	....
	1902	161.97	161.97	....	100.0	....
Virginia	1912	561.86	429.29	132.57	76.4	23.6
	1907	515.54	456.30	59.24	88.5	11.5
	1902	359.30	355.79	3.51	99.0	1.0
West Virginia	1912	404.98	392.48	12.50	96.9	3.1
	1907	266.41	255.22	11.19	95.8	4.2
	1902	140.00	140.00	....	100.0	....
North Carolina	1912	190.26	161.83	28.43	85.1	14.9
	1907	106.94	85.98	20.96	80.4	19.6
	1902	46.32	46.07	0.25	99.5	0.5
South Carolina	1912	202.60	158.77	43.83	78.4	21.6
	1907	131.26	131.26	....	100.0	....
	1902	76.98	76.98	....	100.0	....
Georgia	1912	440.63	241.85	198.78	54.9	45.1
	1907	354.18	354.18	....	100.0	....
	1902	300.38	300.38	....	100.0	....
Florida	1912	164.84	152.47	12.37	92.5	7.5
	1907	118.26	117.26	1.00	99.2	0.8
	1902	61.75	61.75	....	100.0	....
EAST SOUTH CENTRAL:						
Kentucky	1912	493.21	490.02	3.19	99.4	0.6
	1907	389.13	385.36	3.77	99.0	1.0
	1902	283.95	283.95	....	100.0	....
Tennessee	1912	370.28	369.34	0.94	99.7	0.3
	1907	297.50	297.50	....	100.0	....
	1902	254.20	254.20	....	100.0	....
Alabama	1912	306.63	301.91	4.72	98.5	1.5
	1907	291.66	291.16	0.50	99.8	0.2
	1902	204.72	204.72	....	100.0	....
Mississippi	1912	117.14	117.14	....	100.0	....
	1907	86.40	86.40	....	100.0	....
	1902	25.30	25.30	....	100.0	....
WEST SOUTH CENTRAL:						
Louisiana	1912	285.10	155.55	129.55	54.6	45.4
	1907	238.52	119.24	119.28	50.0	50.0
	1902	198.52	198.52	....	100.0	....
All other West South Central states.	1912	1,091.13	1,085.63	5.50	99.5	0.5
	1907	602.70	602.70	....	100.0	....
	1902	355.76	355.76	....	100.0	....
MOUNTAIN:						
Colorado	1912	467.97	434.68	33.29	92.9	7.1
	1907	317.37	317.37	....	100.0	....
	1902	234.53	232.98	1.55	99.3	0.7
Idaho	1912	88.93	12.39	76.54	13.9	86.1
	1907	44.24	44.24	....	100.0	....
	1902	3.50	3.50	....	100.0	....
Utah	1912	260.18	260.18	....	100.0	....
	1907	122.54	114.79	7.75	93.7	6.3
	1902	89.04	89.04	....	100.0	....
All other Mountain states.	1912	190.24	190.24	....	100.0	....
	1907	117.24	117.24	....	100.0	....
	1902	82.41	82.41	....	100.0	....
PACIFIC:						
Washington	1912	1,035.92	1,014.01	21.91	97.9	2.1
	1907	764.73	744.80	19.93	97.4	2.6
	1902	228.93	228.93	....	100.0	....
California	1912	2,605.28	2,472.52	132.76	94.9	5.1
	1907	2,013.49	2,002.81	10.68	99.5	0.5
	1902	829.10	829.10	....	100.0	....
Oregon	1912	544.64	544.64	....	100.0	....
	1907	253.41	253.41	....	100.0	....
	1902	136.67	136.67	....	100.0	....

Leased track.—There has been a considerable increase in the mileage of leased track since 1907, though the proportion that it forms of the total track was smaller in 1912 than in 1907. The 6,922.91 miles of leased track in 1907 constituted 20.1 per cent of the total, but while the mileage had increased to 7,647.96 in 1912, it then constituted but 18.6 per cent of the total mileage. Leased track was reported by companies operating in 34 states in 1912, and in 2 states—Idaho and Rhode Island—almost 90 per cent of the trackage operated was under lease. In 7 states more than 40 per cent was leased, these 7 states reporting 43.5 per cent of the total leased track. There were 8 states in which not more than 2 per cent of the total mileage was leased, while there was no track leased in 15 states, including the District of Columbia. In 16 states the proportion was less in 1912 than in 1907.

In 1912 the track leased from steam roads formed 5.5 per cent of the total leased trackage; in 1907 it constituted 3.9 per cent of all leased track, and in 1902, 1.5 per cent.

Trackage rights.—Track operated under trackage rights is to be considered in determining the total track operated by individual companies. In determining the total miles of track operated in a state or division, trackage rights over the lines of street and electric railway companies are covered by the track mileage reported as owned or leased by the operating companies, but trackage rights over steam railroad lines, not being included in the owned or leased trackage of operating electric railways, must be included in determining the total miles of track over which the street and electric roads operate. In the reports for street and electric railways for 1907 and 1902 track leased from an operating company was shown as operated under trackage rights, to avoid duplication of trackage in the leased track data. Track operated under trackage rights from steam railroad companies, not exclusively operated by the electric railway company but used in conjunction with the owning companies, was included under leased track. In taking the present census provision was made for showing the operated track owned by steam railroad companies separately from that owned by street and electric railways, whether such track was leased and operated exclusively or was operated under trackage rights. The statistics for 1907 and 1902 have been revised to make them comparable with the 1912 figures, except that, since leased trackage and trackage rights, if any, from steam roads are not separable, the track shown as leased from steam companies for these years covers both. Track shown as leased from electric companies for all three census years, as here presented, covers that leased from operating as well as nonoperating companies, the amount of the former being given in footnotes.

In 1912, 1,284.82 miles of track was operated under trackage rights, an amount equal to 3.1 per cent of the total track operated. In 1907 trackage rights aggregated 692.28 miles, or 2 per cent of the total, and in 1902, 559.68 miles, or 2.5 per cent of the total. The detailed statistics for track operated under trackage rights from electric companies and from steam companies are given in Table 153 (p. 282), by states.

Track on private rights of way.—The large increase in track on private rights of way is an important feature of railway development. In 1912, 14,793.72 miles of track, or 36 per cent of the total track operated, was located on private rights of way, as compared with 10,971.84 miles, or 31.9 per cent, in 1907, and 3,802.07 miles, or 16.8 per cent, in 1902. The increase in miles of track for the period 1902–1907 was 11,826.57 miles, of which increase 7,169.77 miles, or over 60 per cent, was on private rights of way. For the period 1907–1912 the increase in track was 6,661.26 miles, of which 3,821.88 miles, or 57.4 per cent, was on private rights of way. The statistics for miles of track located on public thoroughfares and miles of track located on private rights of way are given in Table 153, above referred to. The per cent distribution of track located on public thoroughfares and on private rights of way in the several geographic divisions is as follows:

Table 34

DIVISION.	PER CENT DISTRIBUTION OF MILES OF TRACK, ACCORDING TO LOCATION.					
	On public thoroughfares.			On private rights of way.		
	1912	1907	1902	1912	1907	1902
United States	64.0	68.1	83.2	36.0	31.9	16.8
New England	83.4	88.3	90.9	16.6	11.7	9.1
Middle Atlantic	66.3	68.9	84.7	33.7	31.1	15.3
East North Central	52.4	55.3	76.6	47.6	44.7	23.4
West North Central	70.0	73.6	86.4	30.0	26.4	13.6
South Atlantic	65.6	67.1	73.1	34.4	32.9	26.9
East South Central	73.1	76.8	84.3	26.9	23.2	15.7
West South Central	73.9	88.3	89.3	26.1	11.7	10.7
Mountain	67.8	81.2	94.5	32.2	18.8	5.5
Pacific	54.0	61.8	84.6	46.0	38.2	15.4

The greater proportion of street and electric railway track is on streets or public thoroughfares, but the suburban companies often own their rights of way or have obtained the privilege of operating tracks on private ways, and in districts where interurban lines are extensively developed a large portion of the track is now on private rights of way. Since 1902 track on private ways has increased nearly fourfold, and such track now forms considerably more than one-third of the entire trackage.

States with major portion of track on private rights of way in 1912 were Indiana, with 69.3 per cent; Kansas, with 52.2 per cent; Oklahoma, with 52.4 per cent; Idaho, with 80.8 per cent; and Oregon, with 53.2 per cent. In 1902 the major portion of the track in all states was on public thoroughfares, and in 1907 only two states—Indiana and Idaho—had more than one-half their trackage on private rights of way.

City and suburban and interurban lines.—The schedule employed in taking the census of 1912 provided for classification of track as "city and suburban" or "interurban." At the censuses of 1907 and 1902 track was reported as within or without city limits, but this classification was not applicable to Massachusetts and Connecticut, in which states city and township boundaries are coextensive. Statistics to show the growth of city and suburban lines and interurban lines, respectively, are therefore not available. The statistics for track classified as city and suburban and interurban in 1912 are given in Table 153 (p. 283), by geographic divisions and states. The per cent distribution of city and suburban and interurban trackage for the geographic divisions and states is given in Table 35, which follows:

Table 35

DIVISION AND STATE.	PER CENT DISTRIBUTION OF MILES OF TRACK (BASED UPON TABLE 153).	
	City and suburban.	Interurban.
UNITED STATES	60.1	39.9
GEOGRAPHIC DIVISIONS:		
New England	73.8	26.2
Middle Atlantic	65.6	34.4
East North Central	39.1	60.9
West North Central	73.5	26.5
South Atlantic	71.1	28.9
East South Central	87.3	12.7
West South Central	76.6	23.4
Mountain	66.4	33.6
Pacific	56.4	43.6
NEW ENGLAND:		
Maine	49.1	50.9
New Hampshire	56.7	43.3
Vermont	72.5	27.5
Massachusetts	73.6	26.4
Rhode Island	97.2	2.8
Connecticut	82.6	17.4
MIDDLE ATLANTIC:		
New York	64.9	35.1
New Jersey	79.7	20.3
Pennsylvania	61.8	38.2
EAST NORTH CENTRAL:		
Ohio	32.5	67.5
Indiana	22.8	77.2
Illinois	57.0	43.0
Michigan	39.5	60.5
Wisconsin	48.6	51.4
WEST NORTH CENTRAL:		
Minnesota	93.0	7.0
Iowa	46.9	53.1
Missouri	91.7	8.3
North Dakota	86.2	13.8
South Dakota	100.0	....
WEST NORTH CENTRAL—Continued.		
Nebraska	89.5	10.5
Kansas	46.2	53.8
SOUTH ATLANTIC:		
Maryland	66.3	33.7
Delaware	88.0	12.0
District of Columbia	100.0	....
Virginia	76.5	23.5
West Virginia	36.5	63.5
North Carolina	72.6	27.4
South Carolina	55.6	44.4
Georgia	85.2	14.8
Florida	90.9	9.1
EAST SOUTH CENTRAL:		
Kentucky	74.3	25.7
Tennessee	92.5	7.5
Alabama	100.0	....
Mississippi	92.2	7.8
WEST SOUTH CENTRAL:		
Arkansas	100.0	....
Louisiana	95.3	4.7
Oklahoma	56.9	43.1
Texas	72.1	27.9
MOUNTAIN:		
Montana	92.1	7.9
Colorado	71.4	28.6
New Mexico	89.6	10.4
Arizona	62.3	37.7
Idaho	22.6	77.4
Wyoming	52.0	48.0
Nevada	29.3	70.7
Utah	65.5	34.5
PACIFIC:		
Washington	58.7	41.3
Oregon	44.7	55.3
California	58.0	42.0

The greatest development of interurban track is found in the East North Central division and the least in the East South Central. The leading state, ranked according to miles of interurban track, is Ohio, with 2,747.42 miles, followed by Indiana, New York, Pennsylvania, and Illinois. Ranked according to ratio of interurban track to all track, the leading state is Idaho, with 77.4 per cent, followed by by Indiana, Nevada, Ohio, and West Virginia. In Alabama, Arkansas, District of Columbia, and South Dakota the roads are all classed as city and suburban, and in Rhode Island, Louisiana, Minnesota, Tennessee, Mississippi, Montana, Missouri, and Florida the interurban trackage formed less than 10 per cent of the total.

ROLLING STOCK.

Table 154 (p. 288) presents comparative statistics for rolling stock for 1912, 1907, and 1902, by geographic divisions and states, and Table 155 (p. 290) gives the statistics in detail for 1912 by geographic divisions and states.

Table 36, which follows, shows the numbers of the different varieties of cars and the electric locomotives reported at the censuses of 1912, 1907, and 1902.

Table 36

KIND.	CARS—NUMBER AND KIND.								
	Number.			Per cent of total.			Per cent of increase.[1]		
	1912	1907	1902	1912	1907	1902	1902–1912	1907–1912	1902–1907
Total	94.016	83,641	66,784	100.0	100.0	100.0	40.8	12.4	25.2
Revenue cars	83,956	75,685	61,404	89.3	90.5	92.0	36.7	10.9	23.3
Passenger	76,162	70,016	60,290	81.0	83.7	90.3	26.3	8.8	16.1
Closed	48,123	40,470	32,658	51.2	48.4	48.9	47.3	19.0	23.9
Open	18,993	22,537	24,259	20.2	26.9	36.3	−21.7	−15.7	−7.1
Combination—Closed and open	7,985	6,442	3,134	8.5	7.7	4.7	154.8	24.0	105.6
Passenger, with baggage, express, freight, or mail	1,061	567	239	1.1	0.7	0.4	344.0	87.1	137.2
Express, freight, mail, and baggage	7,794	5,569	1,114	8.3	6.8	1.7	599.6	40.0	399.9
Service cars—work cars, snow plows, sweepers, etc	10,060	7,956	5,380	10.7	9.5	8.0	87.0	26.4	47.9
Prepayment cars	16,012			17.0					
Parlor, sleeping, dining, and private cars	149	118	(2)	0.1	0.1			26.3	
Cars equipped with motors	73,779	63,517	50,699	78.5	75.9	75.9	45.5	16.1	25.3
Electric locomotives	277	117	3					136.8	

[1] A minus sign (−) denotes decrease. (2) Figures not available.

Prepayment cars.—Prepayment cars have been quite generally adopted during the last five years and were reported for the first time in 1912. In the East South Central division 39.9 per cent of all passenger cars were prepayment cars, in the West North Central division 38.7 per cent, and in the other divisions, with the exception of New England and the Mountain states, they are in quite general use.

The growth of freight and express traffic on interurban and rural lines is indicated by the relatively large increase in express and freight cars. Passenger cars with baggage, express, freight, or mail compartments, and express, freight, mail, and baggage cars, together numbered 8,855 in 1912, as compared with 6,136 in 1907 and 1,353 in 1902, an increase for the decade of 554.5 per cent, while the ratio of increase for passenger cars for the decade was 26.3 per cent.

Table 37 shows the distribution, by states, of the express, freight, mail, and baggage cars for states having 100 cars or more in 1912.

Table 37

STATE.	EXPRESS, FREIGHT, MAIL, AND BAGGAGE CARS (NUMBER).					
	1912	1907	1902	Increase.[1]		
				1902–1912	1907–1912	1902–1907
United States	7,794	5,669	1,114	6,680	2,125	4,555
Illinois	1,917	1,384	251	1,666	533	1,133
California	1,507	971	48	1,459	536	923
Washington	816	837	14	802	−21	823
Oregon	494	179	5	489	315	174
New York	428	425	181	247	3	244
Iowa	398	140	41	357	258	99
Ohio	366	305	44	322	61	261
Indiana	328	84	8	320	244	76
Pennsylvania	200	412	51	149	−212	361
Colorado	163	98	1	162	65	97
Maryland	163	76	42	121	87	34
Michigan	138	98	48	90	40	50
Massachusetts	121	91	94	27	30	−3
All other states	755	569	286	469	186	283

[1] A minus sign (−) denotes decrease.

It is apparent that the Pacific coast and the North Central states lead in the growth in freight and express business.

Motor cars.—The number of cars equipped with motors is the number available for service at one time and is comparable with the number of motor equipments for motor cars as reported in 1907. At the census of 1902 the inquiry was for number of cars with electrical equipment. Table 38 shows the distribution of motor cars, by kind of motors and by number of electric motors, in 1912 and 1907.

Table 38

KIND AND NUMBER OF MOTORS.	CARS EQUIPPED WITH MOTORS.				
	1912	1907	Per cent of total.		Per cent of increase.
			1912	1907	
Total number	73,779	63,517			16.2
Electric motors	73,758	63,504	100.0	100.0	16.1
One motor	1,207	629	1.6	1.0	91.9
Two motors	45,996	45,660	62.4	71.9	0.7
Three motors	749	422	1.0	0.7	77.5
Four (or more) motors	25,806	16,793	35.0	26.4	53.7
Gasoline motors	21	13			61.5

The detailed figures for motor equipment, by states, in 1912 are given in Table 155, before referred to. In the West North Central and Pacific divisions four-motor cars constitute more than one-half of the motor cars (57.5 and 53.3 per cent, respectively), and in the Mountain states nearly one-half (46.3 per cent).

Brake equipment.—Table 39 gives the statistics of cars equipped with hand and other types of brakes for 1912, 1907, and 1902, by geographic divisions. The statistics by states for 1912 will be found in Table 155 (p. 291). Air brakes constitute the bulk of those included under "Other types of brakes." This group represents power brakes as distinguished from hand brakes.

Table 39

DIVISION AND STATE.	Census.	CARS—BRAKE EQUIPMENT.				
		Total number.	Cars equipped with—		Per cent of total with brakes.	
			Hand brakes exclusively.	Other types of brakes.	Hand brakes exclusively.	Other types of brakes.
UNITED STATES	1912	[1] 94,016	40,304	53,360	43.0	57.0
	1907	83,641	49,213	34,428	58.8	41.2
	1902	66,784	53,731	13,053	80.5	19.5
GEOGRAPHIC DIVISIONS:						
New England	1912	13,845	8,080	5,758	58.4	41.6
	1907	12,774	8,864	3,910	69.4	30.6
	1902	11,500	9,808	1,692	85.3	14.7
Middle Atlantic	1912	30,507	13,327	17,085	43.8	56.2
	1907	27,884	17,558	10,326	63.0	37.0
	1902	23,263	18,090	5,173	77.8	22.2
East North Central.	1912	21,686	7,107	14,445	33.0	67.0
	1907	20,282	10,195	10,087	50.3	49.7
	1902	15,758	11,807	3,951	74.9	25.1
West North Central.	1912	6,405	1,931	4,457	30.2	69.8
	1907	5,300	2,546	2,754	48.0	52.0
	1902	4,954	4,430	524	89.4	10.6
South Atlantic	1912	6,923	4,832	2,031	70.4	29.6
	1907	6,002	4,837	1,165	80.6	19.4
	1902	4,604	4,177	433	90.6	9.4
East South Central.	1912	2,675	1,653	998	62.4	37.6
	1907	2,361	1,823	538	77.2	22.8
	1902	1,970	1,856	114	94.2	5.8
West South Central.	1912	2,493	1,675	814	67.3	32.7
	1907	1,816	1,362	454	75.0	25.0
	1902	1,279	1,252	27	97.9	2.1
Mountain	1912	1,526	474	1,045	31.1	68.9
	1907	1,030	639	391	62.1	37.9
	1902	690	622	68	90.2	9.8
Pacific	1912	7,956	1,225	6,727	15.4	84.6
	1907	6,192	1,389	4,803	22.4	77.6
	1902	2,766	1,695	1,071	61.3	38.7

[1] Includes 352 cars without brakes.

Electric locomotives.—There were 277 electric locomotives employed by the street and electric railways in 1912, as compared with 117 in 1907 and 3 in 1902. This number does not include those employed on the electrified divisions of steam roads, and those used for the electric haulage of steam trains through tunnels, etc., which were not included in the statistics.

At the census of 1902 there were reported 422 steam locomotives and 3 electric locomotives, 413 of the steam locomotives being in use on the Manhattan Elevated and Brooklyn Rapid Transit systems. These systems were electrified prior to 1907, and at the census covering that year 92 steam locomotives were reported as used in connection with street and electric railways. Steam locomotives were not reported in 1912.

The distribution of the electric locomotives by states is given in Table 155. The statistics by geographic divisions are shown in Table 40, which follows:

Table 40

DIVISION.	ELECTRIC LOCOMOTIVES.			
	1912	1907	1902	Per cent of increase. 1907-1912
United States	277	117	3	136.8
New England	22	15		46.7
Middle Atlantic	39	19		105.3
East North Central	56	21	2	166.7
West North Central	32	10		220.0
South Atlantic	11	3	1	266.7
East South Central	3	2		50.0
West South Central	5	1		400.0
Mountain	10	5		100.0
Pacific	99	41		141.5

There were 341 electric locomotives employed in 1912 on the electrified divisions of steam roads, etc., making a total of 618 for all electrified systems and lines. Table 41 shows their distribution by geographic divisions.

Table 41

DIVISION.	ELECTRIC LOCOMOTIVES—ALL ELECTRIFIED ROADS AND SYSTEMS: 1912.				
	Total number.	Street and electric railways.	Tunnel companies not included with street and electric railways.	Steam railroads.	
				Electrified divisions.	Tunnel haulage.
United States	618	277	122	189	30
New England	27	22			5
Middle Atlantic	219	39		180	
East North Central	189	56	117	4	12
West North Central	32	32			
South Atlantic	22	11		2	9
East South Central	3	3			
West South Central	5	5			
Mountain	15	10	5		
Pacific	106	99		3	4

The 180 electric locomotives in use by steam railroads of the Middle Atlantic division are on the New York divisions of the New York Central & Hudson River and Pennsylvania Railroad systems. The 30 credited to tunnel haulage are employed in the haulage of steam trains through the Hoosac (Mass.) tunnel, the Detroit & St. Clair (Mich.) tunnels, the Baltimore (Md.) tunnel, and the Cascade (Wash.) tunnel.

Track and rolling stock of companies classified according to income from railway operations.—The statistics pertaining to track and rolling stock for all operating companies, classified according to size based upon income from railway operations, are given in Table 42, for 1912, 1907, and 1902.

Table 42

TRACK AND ROLLING STOCK—COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS: 1912, 1907, AND 1902.

	Total.			Class A—$1,000,000 and over.			Class B—$250,000 but less than $1,000,000.			Class C—less than $250,000.		
	1912	1907	1902	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of operating companies	975	945	817	91	77	44	155	132	85	729	736	688
Track.												
Miles of track	41,064.82	34,403.56	22,576.99	21,305.99	15,564.34	8,414.31	9,652.09	8,396.00	4,909.88	10,106.74	10,443.22	9,252.80
Electric	40,808.39	34,059,69	21,901.53	21,212.84	15,394.00	8,030.93	9,613.74	8,378.92	4,814.93	9,981.81	10,286.77	9,055.67
Overhead trolley	38,958.06	32,501.71	21,290.09	20,074.35	14,487.11	7,645.66	9,080.52	7,969.61	4,743.91	9,803.19	10,044.99	8,900.52
Other electric	1,850.33	1,557.98	611.44	1,138.49	906.89	385.27	533.22	409.31	71.02	178.62	241.78	155.15
All other	256.43	343.87	675.46	93.15	170.34	383.38	38.35	17.08	94.95	124.93	156.45	197.13
By ownership:												
Owned	33,416.86	27,480.65	19,025.85	15,170.72	10,119.09	5,543.67	8,545.22	7,421.84	4,468.87	9,700.92	9,939.72	9,013.31
Leased (including trackage rights from steam roads)	7,647.96	6,922.91	3,551.14	6,135.27	5,445.25	2,870.64	1,106.87	974.16	441.01	405.82	503.50	239.49
Operated under trackage rights	1,051.19	692.28	559.68	370.33	198.33	68.04	305.08	151.52	169.67	375.78	342.43	321.97
By location:												
City and suburban	24,699.02	....	....	15,629.37	....	....	4,400.03	....	....	4,669.62	....	....
Interurban	16,365.80	....	....	5,676.62	....	....	5,252.06	....	....	5,437.12	....	....
On public thoroughfares	26,271.10	23,431.72	18,774.92	15,385.05	12,396.65	7,745.38	5,313.11	5,059.75	4,086.86	5,572.94	5,975.32	6,942.68
On private rights of way	14,793.72	10,971.84	3,802.07	5,920.94	3,167.69	668.93	4,338.98	3,336.25	823.02	4,533.80	4,467.90	2,310.12
Rolling stock.												
Cars	94,016	83,641	66,784	67,168	55,692	41,702	14,442	14,323	10,802	12,406	13,626	14,280
Passenger	76,162	70,016	60,290	56,704	49,004	38,543	10,497	10,675	9,645	8,961	10,337	12,102
All other	17,854	13,625	6,494	10,464	6,688	3,159	3,945	3,648	1,157	3,445	3,289	2,178
Electric locomotives	277	117	3	119	22	....	75	52	....	83	43	3

Table 43 shows the percentages of increase from census to census for the principal items given in Table 42.

Table 43

TRACK AND ROLLING STOCK—COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS: PER CENT OF INCREASE (BASED ON TABLE 42).[1]

	1902-1912			1907-1912			1902-1907		
	A	B	C	A	B	C	A	B	C
Miles of track	153.2	96.6	9.2	36.9	15.0	−3.2	85.0	71.0	12.9
Owned	173.7	91.2	7.6	49.9	15.1	−2.4	82.5	66.1	10.3
Leased	113.7	151.0	69.5	12.7	13.6	−19.4	89.7	120.9	110.2
Operated under trackage rights	444.3	79.8	16.7	86.7	101.3	9.7	162.1	−10.7	6.4
On public thoroughfares	98.5	30.0	−19.7	24.0	5.0	−6.7	60.1	23.8	−13.9
On private rights of way	785.1	427.2	96.3	86.9	30.1	1.5	373.5	305.4	93.4
Cars	61.1	33.7	−13.1	20.6	0.8	9.0	33.5	32.6	−4.6
Passenger	47.1	8.8	−26.0	15.7	1.7	−13.3	27.1	10.7	−14.6
All other	231.2	241.0	58.2	56.5	8.1	4.7	111.7	215.3	51.0

[1] A minus sign (−) denotes decrease.

With the exception of track operated under trackage rights, all classes of track and kinds of cars show a greater percentage of increase from 1907 to 1912 for roads included in group A than for those of the smaller groups. In the case of the smaller roads actual decreases are shown for several items.

Table 44 gives the proportion each class of track and kind of car formed of the total for the United States at each census, 1912, 1907, and 1902.

The changes in the proportions that the several classes form of the respective totals show the movement toward larger companies. In the leading items the proportionate gains are largest for class A, and larger for class B than for class C, the latter class showing decreases in many items.

Table 44

TRACK AND ROLLING STOCK—COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS: PER CENT OF TOTAL (BASED ON TABLE 42).

	Class A.			Class B.			Class C.		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Miles of track	51.9	45.2	37.3	23.5	24.4	21.7	24.6	30.4	41.0
Electric	52.0	45.2	36.7	23.6	24.6	22.0	24.4	30.2	41.3
Overhead trolley	51.5	44.6	35.9	23.3	24.5	22.3	25.2	30.9	41.8
Other electric	61.5	58.2	63.0	28.8	26.3	11.6	9.7	15.6	25.3
All other	36.3	49.5	56.7	15.0	5.0	14.1	48.7	45.4	29.2
Owned	45.4	36.8	29.1	25.6	27.0	23.5	29.0	36.2	47.4
Leased	80.2	78.8	80.8	14.5	14.1	12.4	5.3	7.2	6.8
Operated under trackage rights	35.2	28.6	12.1	29.0	21.9	30.3	35.7	49.5	57.6
City and suburban	63.3	......	......	17.8	......	......	18.9	......	......
Interurban	34.7	......	......	32.1	......	......	33.2	......	......
Cars	71.4	66.6	62.4	15.4	17.1	16.2	13.2	16.3	21.4
Passenger	74.5	70.0	63.9	13.8	15.2	16.0	11.8	14.8	20.1
All other	58.6	49.1	48.6	22.1	26.8	17.8	19.3	24.1	33.5
Electric locomotives	43.0	18.8	......	27.1	44.4	......	30.0	36.8	100.0

Track and rolling stock of companies classified as "Elevated and subway" and "Surface."—A similar presentation of the statistics relating to track and cars is given in Table 45 for companies classified by kind of system, based upon location of tracks on elevated or in subway structures, or on surface ways, the latter including all companies with surface tracks predominating.

Table 45

TRACK AND ROLLING STOCK—COMPANIES CLASSIFIED AS "ELEVATED AND SUBWAY," AND AS "SURFACE."

	Total.		Elevated and subway.[1]		Surface.		Per cent of increase.[2]		
	1912	1907	1912	1907	1912	1907	Total.	Elevated, etc.	Surface.
Number of companies	975	945	7	6	968	939	3.2	16.7	3.1
Miles of track	41,064.82	34,403.56	517.81	420.40	40,547.01	33,983.16	19.4	23.2	19.3
Electric	40,808.39	34,059.69	517.81	420.40	40,290.58	33,639.29	19.8	23.2	19.8
Overhead trolley	38,958.06	32,501.71	44.58	25.89	38,913.48	32,475.82	19.9	72.2	19.8
Other electric	1,850.33	1,557.98	[3]473.23	[3]394.51	1,377.10	1,163.47	18.8	20.0	18.4
All other	256.43	343.87	....	....	256.43	343.87	−25.4	....	−25.4
Owned	33,416.86	27,480.65	389.85	291.35	33,027.01	27,189.30	21.6	33.8	21.5
Leased	7,647.96	6,922.91	127.96	129.05	7,520.00	6,793.86	10.5	−0.8	10.7
On public thoroughfares	26,272.10	23,431.72	280.17	301.62	25,991.93	23,130.10	12.1	−7.1	12.4
On private rights of way	14,792.72	10,971.84	237.64	118.78	14,555.08	10,853.06	34.7	100.1	34.1
Rolling stock:									
Cars	94,016	83,641	5,706	4,453	88,310	79,188	12.4	28.1	11.5
Passenger	76,162	70,016	5,524	4,320	70,638	65,696	8.8	27.9	7.5
All other	17,854	13,625	182	132	17,672	13,492	31.0	37.9	31.0
Electric locomotives	277	117	....	....	277	117	136.8	....	136.8

[1] Exclusive of the mixed elevated, subway, and surface systems of Boston, Mass., and Philadelphia, Pa., which are included under "Surface."

[2] A minus sign (—) denotes decrease.

[3] Third rail.

The elevated and subway railways operate in districts of the highest traffic density, and naturally the items for this small group do not form large percentages of the totals of the several items relating to track except in the case of "Other electric," which refers to track of the third-rail system used on the elevated and subway lines. The car equipment of the roads of this group is relatively large, averaging 11 cars per mile of track in 1912 and 10.6 in 1907, compared with 2.2 and 2.3, respectively, for all other lines.

CHAPTER V.

TRAFFIC.

Passengers, car mileage, and car-hours.—The statistics pertaining to traffic are given in Table 156 (p. 292) for 1912, 1907, and 1902, by geographic divisions and states. The table shows the miles of track operated, the number of passengers carried, the revenue car-miles, the revenue car-hours, and the average number of revenue passengers carried per mile of track per car-mile and per car-hour. It is impracticable to make comparisons in detail for each company, consesequently the statistics will be shown for geographic divisions, states, and classified groups of companies.

The state totals relating to passengers, car-miles, and car-hours represent the aggregates for the companies credited to the respective states, and not the net totals for traffic within the territorial limits of the states, since a number of companies operate track in more than one state. The net trackage within each state is shown in Table 29, but it is not possible so to present the statistics of passengers carried.

Car mileage is given for all companies in 1912 and 1907 and for all but 5 companies in 1902, and car-hours for 92.2 per cent of the companies in 1912, 77.7 per cent in 1907, and 47.7 per cent in 1902. On the basis of revenue passengers, the companies reporting car-hours represent 95.1 per cent of the traffic in 1912, 86.3 per cent in 1907, and 45.6 per cent in 1902. The ratios per mile of track are based upon the total trackage operated. The ratios, as a rule, show an increase in density of traffic, the average number of passengers per mile of track being larger in most of the states in 1912 than in 1907 and larger in 1907 than in 1902. The number of passengers per car-mile, in all but a few instances, is also larger.

Number of passengers.—It is probable that more interest centers around the number of passengers carried than around any other feature of the railway service. While the increases in capital, miles of track, rolling stock, etc., show the development of the industry, no other fact is so impressive as the great number of people carried annually on the street and electric railways and the constant increase in passenger traffic.

The total number of passengers in 1912 aggregated 12,135,341,716, as compared with 9,533,080,766 in 1907 and 5,836,615,296 in 1902, the increase being 2,602,260,950, or 27.3 per cent, and 3,696,465,470, or 63.3 per cent, respectively, or 107.9 per cent for the decade. The statistics for 1907 and 1912 include free passengers. This class was not reported separately in 1902 and, if included in that year, probably was reported under the heading "Transfer passengers."

The number of revenue passengers is the basis used for all deductions relating to passengers, since transfer passengers, as a rule, represent a duplication and the number of free passengers has little significance in this connection. Although transfer passengers in some cases pay an additional charge for transfers, the returns do not permit the segregation of passengers paying such extra charge, and in some cases passengers riding on transfer tickets for which an extra charge is made are reported as fare passengers. Table 46 shows the per cent distribution and the per cent increase for revenue passengers, passenger-car mileage, and express, mail, and freight-car mileage, and Table 47 gives the per cent distribution by class of passengers and by geographic divisions for 1912, 1907, and 1902, the proportions being based on the data shown in Table 156.

Table 46 TRAFFIC STATISTICS—PERCENTAGES (BASED ON TABLE 156).

DIVISION.	Per cent distribution.			Per cent of increase.[1]		
	1912	1907	1902	1902–1912	1907–1912	1902–1907
REVENUE PASSENGERS.						
United States	100.0	100.0	100.0	99.9	28.3	55.9
Geographic divisions:						
New England	11.0	11.8	13.5	63.6	20.1	36.2
Middle Atlantic	36.8	38.2	41.4	77.8	23.8	43.7
East North Central	22.6	21.6	20.8	117.8	34.3	62.2
West North Central	8.2	8.3	7.4	123.2	27.9	74.6
South Atlantic	6.5	6.5	6.2	107.5	26.4	64.2
East South Central	2.8	3.0	2.5	128.1	21.7	87.4
West South Central	2.8	2.6	1.9	193.5	40.0	109.6
Mountain	1.6	1.5	1.3	149.1	36.1	83.0
Pacific	7.6	6.6	5.1	198.3	48.2	101.2
REVENUE CAR MILEAGE.						
Passenger.						
United States	100.0	100.0	100.0	68.4	19.1	41.4
Geographic divisions:						
New England	10.0	10.9	12.8	31.8	8.8	21.3
Middle Atlantic	34.9	35.7	35.9	63.7	16.6	40.3
East North Central	24.5	24.8	24.4	69.2	17.5	44.0
West North Central	8.0	8.0	8.2	64.3	19.0	38.0
South Atlantic	6.5	6.6	7.1	54.9	17.2	32.2
East South Central	3.0	3.1	2.9	76.5	18.3	49.2
West South Central	3.2	2.9	2.8	100.4	34.4	49.1
Mountain	1.6	1.4	1.2	116.4	30.1	66.3
Pacific	8.2	6.6	4.8	186.4	48.4	93.0
Express, mail, and freight.						
United States	100.0	100.0	100.0	46.9	5.5	39.3
Geographic divisions:						
New England	8.1	10.1	9.8	21.2	—15.2	43.0
Middle Atlantic	13.2	18.3	72.4	—73.2	—24.1	—64.7
East North Central	35.3	32.3	8.7	493.2	15.1	415.1
West North Central	6.3	3.4	2.5	282.8	95.3	96.0
South Atlantic	4.5	2.6	3.8	74.5	84.1	—5.2
East South Central	1.7	2.0	0.6	327.0	—13.5	393.7
West South Central	1.5	1.9	0.2	884.6	—19.5	1,122.6
Mountain	0.7	1.2	0.2	508.4	—35.9	849.1
Pacific	28.7	28.1	1.8	2,182.6	7.7	2,020.1

[1] A minus sign (—) denotes decrease.

Table 47 REVENUE, TRANSFER, AND FREE PASSENGERS—PER CENT DISTRIBUTION (BASED ON TABLE 156).

DIVISION.	Revenue.			Transfer.			Free.		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
United States	78.7	78.1	81.8	20.0	20.9	18.2	1.4	1.0	......
New England	76.2	77.1	79.8	22.6	22.4	20.2	1.2	0.5	......
Middle Atlantic	85.2	80.8	84.7	14.0	18.4	15.3	0.8	0.8	......
East North Central	72.7	75.1	79.5	25.5	23.8	20.5	1.8	1.1	......
West North Central	74.0	74.2	76.6	24.9	24.8	23.4	1.1	1.0	......
South Atlantic	77.9	78.4	79.1	20.6	20.1	20.9	1.4	1.5	......
East South Central	78.6	78.8	87.9	19.3	19.0	12.1	2.1	2.2	......
West South Central	81.9	86.4	92.0	16.2	12.1	8.0	1.9	1.5	......
Mountain	83.2	81.2	83.4	15.0	17.1	16.6	1.8	1.6	......
Pacific	76.3	75.3	78.8	21.3	23.3	21.2	2.4	1.4	......

Table 48 shows the "per cent ratio" (ratio expressed as percentage) which the number of transfer and free passengers (combined) bears to the number of revenue passengers in each division and state for 1912 and 1907:

Table 48

DIVISION AND STATE.	PER CENT RATIO OF TRANSFER AND FREE PASSENGERS TO REVENUE PASSENGERS (BASED ON TABLE 156).	
	1912	1907
UNITED STATES	27.1	28.1
GEOGRAPHIC DIVISIONS:		
New England	31.3	29.7
Middle Atlantic	17.4	23.7
East North Central	37.5	33.1
West North Central	35.1	34.8
South Atlantic	28.3	27.6
East South Centra	27.3	26.9
West South Central	22.1	15.8
Mountain	20.2	23.1
Pacific	31.1	32.9
NEW ENGLAND:		
Maine	13.0	10.7
New Hampshire	12.6	9.6
Vermont	7.7	5.0
Massachusetts	38.1	36.3
Rhode Island	16.3	14.4
Connecticut	20.4	19.3
MIDDLE ATLANTIC:		
New York	16.3	28.1
New Jersey	26.9	28.3
Pennsylvania	16.4	14.5
EAST NORTH CENTRAL:		
Ohio	28.8	26.6
Indiana	22.2	22.9
Illinois	49.6	41.2
Michigan	29.4	29.4
Wisconsin	30.7	28.8
WEST NORTH CENTRAL:		
Minnesota	33.5	28.9
Iowa	17.2	19.8
Missouri	43.2	42.3
North Dakota	7.6	12.5
South Dakota	5.5	....
Nebraska	28.1	25.2
Kansas	16.3	17.9
SOUTH ATLANTIC:		
Delaware	21.4	22.6
Maryland	39.2	38.8
Dist. of Columbia	34.9	42.5
Virginia	24.6	14.6
West Virginia	6.4	4.4
North Carolina	20.1	12.6
South Carolina	20.7	16.5
Georgia	19.6	20.3
Florida	25.0	17.6
EAST SOUTH CENTRAL:		
Kentucky	27.7	25.6
Tennessee	33.0	34.6
Alabama	19.8	20.5
Mississippi	18.1	13.5
WEST SOUTH CENTRAL:		
Arkansas	11.3	22.0
Louisiana	24.4	11.3
Oklahoma	15.2	16.7
Texas	22.8	19.0
MOUNTAIN:		
Montana	13.5	16.4
Colorado	24.1	27.5
New Mexico	9.4	44.3
Arizona	4.6	8.3
Idaho	10.3	13.6
Wyoming	1.0	....
Nevada	....	6.6
Utah	18.4	25.2
PACIFIC:		
Washington	29.2	28.9
Oregon	33.4	29.3
California	31.2	34.7

In 1912 the number of transfer and free passengers was equal to 27.1 per cent of the number of revenue passengers, as compared with 28.1 per cent in 1907. In the Middle Atlantic, Mountain, and Pacific divisions there appears a ratio decrease, and in the other divisions a ratio increase. The ratio was greater in 1912 than in 1907 in 27 states, and less in 21 states, including the District of Columbia, while in 1 state, Michigan, it remained the same.

Diagram 2 (p. 193) shows graphically the revenue passenger traffic for 1912, 1907, and 1902, by states.

Car mileage.—The car-mile is in general use for comparative purposes, but statistics and averages based thereon are affected by differences in size of cars, by varying conditions under which they are operated, and by lack of uniformity in the method of computing car-mileage when trailers are used, a motor and trailer being in some cases counted as one and in some cases as two cars. Table 49 gives the per cent of increase in revenue car mileage for the five-year periods 1907–1912 and 1902–1907, and for the decade, by geographic divisions, based upon the statistics reported in Table 156, and the per cent distribution of revenue car mileage as between passenger cars and express, mail, and freight cars.

Table 49 REVENUE CAR MILEAGE—PER CENT OF INCREASE AND PER CENT DISTRIBUTION (BASED ON TABLE 156).

DIVISION.	Per cent of increase.			Per cent distribution.					
				Passenger.			Express, mail, and freight.		
	1902–1912	1907–1912	1902–1907	1912	1907	1902	1912	1907	1902
United States	67.9	18.8	41.4	98.1	97.9	97.9	1.9	2.1	2.1
New England	31.8	8.3	21.6	98.5	98.1	98.4	1.5	1.9	1.6
Middle Atlantic	57.9	16.2	35.9	99.3	98.9	95.8	0.7	1.1	4.2
East North Central	72.5	17.4	46.9	97.3	97.3	99.2	2.7	2.7	0.8
West North Central	65.7	19.7	38.4	98.5	99.1	99.4	1.5	0.9	0.6
South Atlantic	55.1	17.7	31.7	98.7	99.2	98.9	1.3	0.8	1.1
East South Central	77.6	17.8	50.7	99.0	98.6	99.6	1.0	1.4	0.4
West South Central	101.7	33.6	51.0	99.1	98.6	99.8	0.9	1.4	0.2
Mountain	117.5	29.0	68.6	99.2	99.2	99.7	0.8	0.8	0.3
Pacific	202.9	45.0	108.8	93.8	91.6	99.2	6.2	8.4	0.8

The increase or decrease in the proportion of express, mail, and freight-car mileage is, in a measure, an indication of the proportionate increase or decrease of such business, although income, which is considered in Chapter VII, is a better basis of comparison.

Revenue passengers per mile of track.—The number of revenue passengers per mile of track is a measure of the density of traffic. The extension of lines into rural districts, where travel is relatively light, tends to reduce the average number of passengers carried per mile of track and is a factor that affects comparative averages. Furthermore, the combination of data for companies located in different cities and in cities and rural districts results in an average that may be misleading. In general, however, such an average is an index of the growth in passenger traffic. The statistics given in Table 156 show an increase of 16,034, or 7.4 per cent, in the number of revenue passengers per mile of track for 1912 as compared with 1907, and an increase of 4,263, or 2 per cent, for 1907 as compared with 1902.

The averages by states, excluding the District of Columbia, ranged in 1912 from a minimum of 46,885 in Idaho to a maximum of 461,837 in New York, and in 1907 from a minimum of 25,103 in South Dakota to a maximum of 426,718 in New York. The explanation of the decrease in averages for some states is found in the extension of lines and not in the diminution of traffic on old lines.

Revenue passengers per car-mile.—The average number of revenue passengers per passenger-car mile is a deduction that is affected by the size of cars and the method of counting passengers on suburban and interurban lines, whether by zones or by trips. There is no basis for determining the extent of these disturbing factors, but in the main the averages have increased. In 1912 the average number of revenue passengers per passenger-car mile for all companies was 5.06, as compared with 4.70 in 1907 and 4.26 in 1902.

The states showing decreases in average number of revenue passengers per passenger-car mile (Table 156) in 1912 as compared with 1907 also, as a rule, show decreases in traffic per mile of track, and the explanation lies, as before stated, in track extensions in rural districts.

Revenue passengers per passenger-car hour.—Although car-hour statistics are not kept by all companies, the number reporting is sufficient to furnish a basis for computing averages that will be approximately correct. In 1912 the average number per car hour was 48.38, as compared with 43.06 in 1907, and 33.28 in 1902, the percentages of increase from 1907 to 1912 and from 1902 to 1907 being, respectively, 12.4 and 29.4. In only a few states does there appear to be a decrease for 1912, as compared with 1907 or 1907 as compared with 1902. Of course these figures are affected by changes in size of cars.

Traffic of maximum density.—Table 50 presents traffic statistics for selected roads in the cities of New York, Chicago, Philadelphia, and Boston, representing districts of high traffic density.

Table 50

TRAFFIC OF MAXIMUM DENSITY — SELECTED RAILWAYS: 1912, 1907, AND 1902.

	Census.	Miles of track operated.	Number of revenue passengers.	Passenger car-miles.	Average number of revenue passengers—	
					Per mile of track.	Per car-mile.
New York City (Manhattan and Bronx Boroughs):						
Surface, elevated, and subway.	1912	707.74	1,108,237,017	206,840,174	1,565,882	5.36
	1907	651.94	862,067,604	165,075,775	1,322,311	5.22
	1902	510.06	626,977,169	111,031,925	1,229,222	5.65
Surface	1912	485.61	442,913,126	66,452,736	912,057	6.67
	1907	461.41	412,779,720	66,283,005	894,605	6.23
	1902	392.92	411,717,824	65,960,182	1,047,841	6.24
Elevated and subway.	1912	222.13	665,323,891	140,387,438	2,995,200	4.74
	1907	190.53	449,287,884	98,792,770	2,358,095	4.55
	1902	117.14	215,259,345	45,071,743	1,837,625	4.78
Chicago:						
Surface and elevated.	1912	1,021.35	736,826,675	146,639,590	721,424	5.02
	1907	933.95	548,618,412	122,213,396	587,417	4.49
	1902	855.59	394,656,000	96,546,464	461,268	4.09
Surface	1912	829.84	572,512,151	99,031,422	689,907	5.78
	1907	787.35	411,083,347	86,136,759	522,110	4.77
	1902	734.33	294,809,570	69,391,892	401,467	4.25
Elevated	1912	[1] 191.51	164,314,524	47,608,168	847,551	3.45
	1907	[2] 146.60	137,535,065	36,076,637	938,166	3.81
	1902	121.26	99,846,430	27,154,572	823,408	3.68
Philadelphia:						
Surface	1912	[3] 649.72	456,926,814	83,035,669	703,267	5.50
	1907	[4] 619.85	424,275,833	81,263,251	684,481	5.22
	1902	475.46	325,801,963	59,375,543	685,235	5.49
Boston:						
Surface, elevated, and subway.	1912	[5] 500.52	310,310,009	54,564,478	619,975	5.69
	1907	[6] 457.65	271,084,815	51,830,188	592,341	5.23
	1902	404.94	222,484,811	45,772,836	549,427	4.86

[1] Includes 47.30 miles of surface tracks.

[2] Includes 20.83 miles of surface tracks.

[3] Includes 9.87 miles of elevated and 8.42 miles of subway tracks.

[4] Includes 7.67 miles of elevated and 3.23 miles of subway tracks.

[5] Includes 456.59 miles of surface, 26.58 miles of elevated, and 17.35 miles of subway tracks.

[6] Includes 433.20 miles of surface, 16.70 miles of elevated, and 7.75 miles of subway tracks.

The maximum density of passenger traffic centers in Manhattan and The Bronx boroughs of New York City, and the average for these boroughs increased by 243,571 passengers per mile of track from 1907 to 1912 and by 93,089 from 1902 to 1907. The increase is essentially all in the traffic of the elevated and subway lines.

The increase in the traffic of these lines was 637,105 revenue passengers per mile of single track, or 27 per cent, from 1907 to 1912, and 520,470, or 28.3 per cent, from 1902 to 1907. Some of the inclined-plane cable companies show high traffic density, owing to the traffic being confined to short lengths of track—fractions of a mile—but, excluding such cable roads, the densest traffic is found in the subway systems of New York City.

Table 51 gives the traffic density statistics for the exclusively cable roads for 1912, 1907, and 1902. The two surface cable roads in 1912 were the California Street Cable Railroad Co. and the Geary Street Park and Ocean Railway Co. of San Francisco, which latter was operated only part of the year and the tracks then removed to make way for the municipal road. The 11 inclined-plane cable roads are located, 4 in Pennsylvania, 3 in California, and 1 each in the states of Minnesota, Ohio, Tennessee, and Virginia.

Table 51

TRAFFIC OF EXCLUSIVELY CABLE ROADS: 1912, 1907, AND 1902.

	Census.	Number of companies.	Miles of track operated.	Number of revenue passengers.	Passenger car-miles.	Average number of revenue passengers—	
						Per mile of track.	Per car-mile.
Total	1912	13	24.60	15,837,850	1,869,598	643,815	8.47
	1907	10	20.70	11,993,943	1,050,940	579,418	11.41
	1902	12	23.65	16,066,958	2,499,078	679,364	6.42
Inclined plane	1912	11	6.67	5,575,519	422,942	835,910	13.18
	1907	8	2.91	4,470,450	244,911	1,536,237	18.25
	1902	10	5.11	3,768,835	284,466	737,541	13.25
Surface	1912	2	17.93	10,262,331	1,446,656	572,355	7.09
	1907	2	17.79	7,523,493	806,029	422,906	9.33
	1902	2	18.54	12,298,123	2,214,612	663,329	5.55

Passenger traffic of street and electric railways and steam railroads.—A comparison of the passenger traffic of street and electric railways and steam railroads, given in Table 52, shows the relatively large and rapid growth of the former.

Table 52

PASSENGER TRAFFIC—STREET AND ELECTRIC RAILWAYS AND STEAM RAILROADS.[1]

	1912	1907	1902	Per cent of increase.		
				1902-1912	1907-1912	1902-1907
Number of revenue passengers:						
Street and electric railways.	9,545,554,667	7,441,114,508	4,774,211,904	100.0	28.3	55.9
Steam railroads	1,004,081,346	873,905,133	649,878,505	54.5	14.9	34.5
Receipts from passengers:						
Street and electric railways.	$502,651,637	$382,132,494	$233,821,548	115.0	31.5	63.4
Steam railroads	660,373,176	564,606,343	372,963,248	77.1	17.0	51.4

[1] Steam railroad statistics from reports of the Interstate Commerce Commission.

The 1,004,081,346 passengers carried by the steam roads in 1912 traveled an average distance of 33.18 miles. An average distance of travel for the electric-railway passengers is not determinable. The average fare per passenger for street and electric railways was 5.27 cents, as compared with 65.68 cents for the steam roads. The combined passenger receipts for street and electric and steam roads were $1,163,024,813 in 1912, $946,738,837 in 1907, and $606,784,796 in 1902. Of these totals, the street and electric railway passenger receipts constituted 43.2 per cent in 1912, 40.4 per cent in 1907, and 38.5 per cent in 1902.

Traffic of companies classified according to income from railway operations.—A study of the statistics for companies classified according to income from railway operations shows a marked increase in the larger classes.

Table 53 TRAFFIC STATISTICS—COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS: CLASS A, $1,000,000 AND OVER; CLASS B, $250,000 BUT LESS THAN $1,000,000; CLASS C, LESS THAN $250,000.

	1912	1907	1902	Per cent of increase.[1]		
				1902–1912	1907–1912	1902–1907
Number of companies	975	945	817	19.3	3.2	15.7
Class A	91	77	44	106.8	18.2	75.0
Class B	155	132	85	82.4	17.4	55.3
Class C	729	736	688	6.0	−1.0	7.0
Miles of track	41,064.82	34,403.56	22,576.99	81.9	19.4	52.4
Class A	21,305.99	15,564.34	8,414.31	153.2	36.9	85.0
Class B	9,652.09	8,396.00	4,909.88	96.6	15.0	71.0
Class C	10,106.74	10,443.22	9,252.80	9.2	−3.2	12.9
Passengers:						
Revenue	9,545,554,667	7,441,114,508	4,774,211,904	99.9	28.3	55.9
Class A	7,635,471,119	5,626,200,180	3,357,796,250	127.4	35.7	67.6
Class B	1,148,582,234	1,035,885,754	737,552,043	55.7	10.9	40.4
Class C	761,501,314	779,028,574	678,863,611	12.2	−2.2	14.8
Transfer and free	2,589,787,049	2,091,966,258	1,062,403,392	143.8	23.8	96.9
Class A	2,315,998,173	1,815,692,175	837,046,245	176.7	27.6	116.9
Class B	194,959,266	196,273,141	140,733,373	38.5	−0.7	39.5
Class C	78,829,610	80,000,942	84,623,774	−6.8	−1.3	−5.4
Car mileage:						
Passenger	1,885,870,157	1,583,831,199	1,120,101,944	68.4	19.1	41.4
Class A	1,413,227,890	1,119,283,959	712,095,206	98.5	26.3	57.2
Class B	271,494,787	250,463,695	192,487,450	41.0	8.4	30.1
Class C	201,147,480	214,083,545	215,519,288	−6.7	−6.0	−0.7
Express, mail, and freight	35,749,917	33,900,101	24,328,522	46.9	5.5	39.3
Class A	20,372,141	16,308,555	19,787,652	3.0	24.9	−17.6
Class B	10,096,974	11,970,950	1,873,373	439.0	−15.7	539.0
Class C	5,280,802	5,620,596	2,667,497	98.0	−6.0	110.7
Average number of revenue passengers:						
Per mile of track[2]	232,556	216,522	212,217	......	......	......
Class A	358,372	361,701	399,058	......	......	......
Class B	118,998	123,390	150,218	......	......	......
Class C	75,484	74,788	74,009	......	......	......
Per car-mile	5.06	4.70	4.26	......	......	......
Class A	5.40	5.03	4.72	......	......	......
Class B	4.23	4.14	3.83	......	......	......
Class C	3.79	3.64	3.15	......	......	......

[1] A minus sign (—) denotes decrease.
[2] Exclusive of idle track and track of freight roads.

The average number of revenue passengers per mile of track shows a decrease at each census since 1902 for each class except class C, in which there was a slight increase from census to census.

Traffic of companies classified as "Elevated and subway" and "Surface."—Similar comparative statistics are given in Table 54 for the group of "Elevated and subway" roads, and all other roads, designated as "Surface."

Table 54 TRAFFIC STATISTICS—"ELEVATED AND SUBWAY" AND "SURFACE."

	1912	1907	Per cent of increase.[1]
Number of companies	975	945	3.2
Elevated and subway	7	6	16.7
Surface	968	939	3.1
Miles of track	41,064.82	34,403.56	19.4
Elevated and subway	517.81	420.40	23.2
Surface	40,547.01	33,983.16	19.3
Passengers:			
Revenue	9,545,554,667	7,441,114,508	28.3
Elevated and subway	991,062,330	635,653,072	55.9
Surface	8,554,492,337	6,805,461,436	25.7
Transfer and free	2,589,787,049	2,091,966,258	23.8
Elevated and subway	13,760,495	5,051,921	172.4
Surface	2,576,026,554	2,086,914,337	23.4
Car mileage:			
Passenger	1,885,870,157	1,583,831,199	19.1
Elevated and subway	219,374,647	143,268,267	53.1
Surface	1,666,495,510	1,440,562,932	15.7
Express, mail, and freight	35,749,917	33,900,101	5.5
Elevated and subway	92,625	366,208	−74.7
Surface	35,657,292	33,533,893	6.3
Average number of revenue passengers:			
Per mile of track[2]	232,556	216,522	....
Elevated and subway	1,913,950	1,514,866	....
Surface	211,073	200,386	....
Per car-mile	5.06	4.70	....
Elevated and subway	4.52	4.44	....
Surface	5.13	4.72	....

[1] A minus sign (—) denotes decrease.
[2] Exclusive of idle track and track of freight roads.

The number of revenue passengers per car-mile necessarily represents the average for all service, as the statistics do not permit a showing of the average number per car-mile during the hours of heavy travel. It would perhaps be expected that the congested traffic on the elevated and subway lines during the rush hours of morning and evening would result in a large average for these lines, but the average is less than that for the surface roads. The congestion during these rush hours is more than offset by lightness of traffic during the intermediate periods.

Car-hours.—The car-hour was employed in 1912 by 92.1 per cent of the companies, with 95.1 per cent of the revenue passengers, while this unit was used in 1907 by only 77.6 per cent of the companies, with 86 per cent of the revenue passengers, and in 1902 by only 47.7 per cent of the companies, with 45.6 per cent of the passengers. Table 55 gives the comparative traffic statistics for car-hours.

Table 55	TRAFFIC STATISTICS—CAR-HOURS.		
	1912	**1907**	**1902**
Number of companies	975	945	817
Reporting car-hours	898	733	390
Not reporting car-hours	77	211	427
Per cent of total:			
Reporting car-hours	92.1	77.6	47.7
Not reporting car-hours	7.9	22.4	52.3
Revenue car-hours	190,478,140	151,338,944	65,869,342
Passenger	187,590,223	148,678,052	65,403,287
Express, mail, and freight	2,887,917	2,660,892	466,055
Number of revenue passengers:			
Total	9,545,554,667	7,441,114,508	4,774,211,904
Companies—			
Reporting car-hours	9,075,785,815	6,401,840,576	2,176,886,559
Not reporting car-hours	469,768,852	1,039,273,932	2,597,325,345
Per cent of total:			
Companies—			
Reporting car-hours	95.1	86.0	45.6
Not reporting car-hours	4.9	14.0	54.4
Average number of revenue passengers per passenger-car hour for companies reporting car-hours	48.38	43.06	33.28

Rates of fare.—The rate of cash fare on nearly all of the street and electric railways is 5 cents. There are, however, exceptions to this rule varying from the 3-cent rate in Cleveland to the 6-cent rate charged in many of the towns of Massachusetts, and also reported for Warehouse Point, Conn., and Laconia, N. H. For the street and electric railways of the country as a whole the average revenue per passenger carried, obtained by dividing the receipts from passengers by the number of revenue passengers carried, was 5.27 cents in 1912, 5.15 cents in 1907, and 4.94 cents in 1902. The increase is due almost entirely to the development of interurban roads and the increasing practice of issuing a single-fare ticket for the entire distance traveled by the passenger, in much the same manner as on steam roads.

Table 56 shows the average revenue per revenue passenger for the different classes of street and electric railways and for steam railroads, for 1912, 1907, and 1902.

Table 56	TRAFFIC STATISTICS—AVERAGE PASSENGER REVENUE PER REVENUE PASSENGER.		
	1912	**1907**	**1902**
STREET AND ELECTRIC RAILWAYS.	*Cents.*	*Cents.*	*Cents.*
All companies	5.27	5.15	4.94
Companies classified according to income from railway operations:			
Class A—$1,000,000 and over	5.08	4.99	4.84
Class B—$250,000 but less than $1,000,000	6.10	5.61	5.59
Class C—Less than $250,000	5.87	4.98	5.09
Companies classified according to kind of system:			
Elevated and subway	5.08	4.97	....
Surface	5.29	5.17	....
STEAM RAILROADS.			
Revenue per passenger	65.68	64.60	60.49
Journey per passenger (miles)	33.18	31.72	30.30
Revenue per passenger per mile	1.99	2.01	1.99

There appears a slight increase in the averages for 1912 as compared with 1907 and for 1907 as compared with 1902. The high averages for roads of class B are due to the inclusion in that group of a large number of the leading interurban lines, some of which report trip passengers rather than zone passengers. Class C is likewise influenced by the same factor to a considerable extent. More than half of the trackage of these two groups is classed as interurban. On the other hand, class A includes most of the large city systems, and only 26.6 per cent of its trackage is classed as interurban.

Table 57 is a summary of the information furnished in answer to the following inquiry: "Fare charged per passenger within city limits. (If line operates in two or more cities, give names of cities, and fare charged in each. If reduced fare is granted by sale of tickets or otherwise, give each rate with short statement of thefacts.)"

The returns made to the Bureau of the Census show that a large percentage of the operating street and electric railways offer fares of less than 5 cents to all of their patrons under certain conditions. In most cases the cash fare for a single trip is 5 cents, but tickets for a number of trips are sold at reduced rates. In a few cases in New England the cash fare is 6 cents in winter and 5 cents the rest of the year. The practice of selling workingmen's tickets at a reduced rate, while not universal, is becoming more extended. Their use is limited to the hours of travel to and from work, usually from 6 to 8 a. m. and from 5 to 7 p. m. In some cases, as explained in notes at the end of the table, family tickets are sold at reduced rates, also employees' family tickets, police tickets, mail carriers' tickets, etc., and in Manitou, Colo., tickets to residents. By far the most common practice with companies giving reduced rates is the sale of six tickets for 25 cents; although in many cities a greater number—8, or even 10—are sold for that amount. On a considerable number of lines the reduced fare is given only to those who buy tickets to the value of $1. The usual rule of such companies is to sell 21, 24, or 25 tickets for $1. Occasionally the purchase of a still larger number of tickets is required in order that the reduced fare may be obtained. In Bakersfield, Cal., 110 tickets are sold for $5; in Petaluma, Cal., 100 for $4.25 or 200 for $7.50; in Meridian, Miss., 500 for $20; and in Peekskill, N. Y., 1,000 for $45. In some cases books of tickets are sold with a time limit, as in parts of Illinois, where 100-ride books with a 60-day limit are sold for $4, but with a 30-day limit for $3. It is probable that in a number of cases where companies have reported the sale of 25 tickets for $1, 6 tickets are also sold for 25 cents, the companies reporting only the minimum fare rate by ticket.

STREET AND ELECTRIC RAILWAYS—RATES OF FARE WITHIN CITY LIMITS BY GEOGRAPHIC DIVISIONS AND STATES.

[See notes at the end of this table, p. 221.]

Table 57

DIVISION, STATE, AND CITY.	RATES OTHER THAN 5 CENTS. Tickets—Number for amount indicated.	Children—Rate of fare.	School tickets—Rate of fare.	Working-men's tickets—Rate of fare.
NEW ENGLAND.				
Maine:		*Cents.*	*Cents.*	*Cents.*
Bangor			2.5	
Bremer			2.5	
Brunswick			2	
Freeport [1]	11 for 50 cents		2.5	
Lewiston [2]	do		2.5	
Madison	10 for 25 cents			
Oldtown			2.5	
Rockland			2.5	
Skowhegan	10 for 25 cents			
Topsham			2	
New Hampshire:				
Claremont [3]				
Derry	(4)			
Exeter [5]	50 for $2.50		3	
Hampton [5]	do	2.5	3	[6]3.75
Hampton Falls		2.5		[6]3.75
Hudson [3]		2.5		[6]3.75
Keene [7]				
Laconia [8]				
Marlboro [7]				
Nashua [3]		2.5		[6]3.75
Newton		2.5		[6]3.75
Pelham [3]		2.5		[6]3.75
Plaistow		2.5		[6]3.75
Portsmouth			3	
Salem [3]		2.5		[6]3.75
Seabrook		2.5		[6]3.75
Swanzey [7]				
Vermont:				
Barre			2.5	2.5
Brattleboro [9]	20 for $1		3	
Montpelier			2.5	2.5
Massachusetts:				
Acton [8]				
Amesbury			2.5	[6]3.75
Amherst [8]	17 for $1		3	3.60
Attleborough			2.5	
Brookfield [8]				5.70
Canton [8]				
Deerfield [8]			3	3.60
Dracut			2.5	[8]3.75
Fall River	6 for 25 cents		[10]2.5	
Fitchburg [11]			2.5	
Franklin			2.5	
Greenfield [8]			3	3.60
Hadley [8]			3	3.60
Hanson [8]			3	
Hatfield [8]			3	3.60
Haverhill [3]			2.5	[6]3.75
Holyoke			2.5	
Kingston [8]			3	
Lakeville			2.5	
Lawrence			2.5	[6]3.75
Leominster [11]			2.5	
Linwood	25 for $1		2.5	2.5
Lowell			2.5	3.75
Marlborough [8]				3.33
Merrimac			2.5	[8]3.75
Methuen			2.5	[6]3.75
Middleborough			2.5	
Milton [8]				
Montague [8]			3	3.6
New Bedford	21 for $1			
Newbury			2.5	[6]3.75
Newburyport			2.5	[8]3.75
Newton [8]				
Northampton [8]			3	3.6
North Brookfield [8]				5.7
Pembroke [8]			3	
Pittsfield [12]			2.5	
Plymouth [8]			3	
Randolph			2.5	
Salisbury			2.5	[6]3.75
Spencer [8]				5.7
Springfield			2.5	
Stoughton [8]			2.5	
Taunton			2.5	2.5
Warren [8]				5.7
West Brookfield [8]				5.7
Whately [8]			3	3.6
Whitinsville	25 for $1		2.5	2.5
Whitman [8]			3	
Worcester [13]			2.5	(14)
Rhode Island:				
Newport			2.5	
Woonsocket			2.5	
NEW ENGLAND—Contd.				
Connecticut:		*Cents.*	*Cents.*	*Cents.*
Bristol	(15)		3	
Danbury	21 for $1		2.5	
New Britain	do		[18]2.5	
New Haven			3	
Warehouse Point [8]			3	
Waterbury	25 for $1		[16]2.5	
MIDDLE ATLANTIC.				
New York:				
Amsterdam	24 for $1		2.5	
Auburn	22 for $1			
Ballston Spa	100 for $4		3.5	
Batavia	8 for 25 cents			
Brooklyn [17]		3		
Canisteo	6 for 25 cents			
Cortland	do			
Geneva	24 for $1	3		
Gloversville	do		2.5	
Hoosick Falls [18]			2.5	
Hornell	6 for 25 cents			
Huntington	12 for 50 cents		2.5	
Ithaca			3	
Jamestown	11 for 50 cents			
Johnstown	24 for $1		2.5	
Kingston	21 for $1			—
New Brighton [19]			4	
New York [20]		3		
Ogdensburg	6 for 25 cents	3		
Oneida		3		
Ossining	20 for 50 cents			
Oswego	22 for $1			
Peekskill	1,000 for $45			
Plattsburg	6 for 25 cents [21]			
Port Chester [22]			2.5	
Poughkeepsie	21 for $1			
Rochester		3		
Rome		3		
Schenectady		2.5		
Syracuse		3		
Utica		3		
Watertown	25 for $1			
Williamsville	8 for 15 cents			
New Jersey:				
Bridgeton	6 for 25 cents [23]			
Newark [24]			3	
Trenton	6 for 25 cents			
Vineland			2.72	
Pennsylvania:				
Bloomsburg				3.75
Butler	6 for 25 cents			
Chambersburg	do			
Connellsville			3.12	
Dubois	6 for 25 cents [25]		2.5	
Duquesne	7 for 25 cents			
Easton	25 for $1			
Franklin		3	2.5	
Hanover		3		
Hershey	6 for 25 cents			
Homestead	24 for $1		2.5	
Juniata	500 for $20			
Kittanning	22 for $1			
Lancaster	6 for 25 cents			
Littlestown		3		
Lock Haven	6 for 25 cents			
McKeesport	8 for 25 cents [26]			
McSherrystown		3		
Mauch Chunk	22 for $1 [27]			
Mount Carmel	6 for 25 cents	2.5		3.33
New Castle	11 for 50 cents			
New Kensington			3	
Oil City		3	2.5	
Patton	50 for $2			3
Philadelphia [28]				
Pottsville	24 for $1			
Punxsutawney	50 for $2.25		2.5	
Shamokin	6 for 25 cents [23]	2.5		3.12
Stroudsburg	25 for $1			
Sunbury	6 for 25 cents			
Titusville	do		3	3
Tyrone	do			
Williamsport	do			
York	do. [23]			

STREET AND ELECTRIC RAILWAYS—RATES OF FARE WITHIN CITY LIMITS, BY GEOGRAPHIC DIVISIONS AND STATES—Continued.

[See notes at the end of this table, p. 221.]

Table 57—Contd.

DIVISION, STATE, AND CITY.	RATES OTHER THAN 5 CENTS. Tickets—Number for amount indicated.	Children—Rate of fare.	School tickets—Rate of fare.	Working-men's tickets—Rate of fare.
EAST NORTH CENTRAL.				
Ohio:		*Cents.*	*Cents.*	*Cents.*
Akron	6 for 25 cents			
Ashtabula	25 for $1	3		
Bellefontaine	6 for 25 cents			
Blissfield	8 for 25 cents			
Brilliant	11 for 50 cents			
Cambridge	6 for 25 cents			
Canton	do.[23]			
Chillicothe	do.[29]	2.5		
Cincinnati [30]				
Cleveland, *cash fare*	3 cents			
Columbus	8 for 25 cents			
Conneaut	25 for $1	3		
Coshocton	7 for 25 cents			
Dayton	6 for 25 cents [23]	[31] 3		
Defiance	do			
Delaware	do.[23]	2.5		
Findlay	25 for $1			
Fostoria	6 for 25 cents [32]	2.1		
Gallipolis	do			
Hamilton	do			
Lancaster	6 for 25 cents [33]			
Lima	do			
Mansfield	do.[23]			
Marion	do.[23]	2.5		
Middletown	8 for 25 cents			
Mingo Junction	11 for 50 cents			
Mount Vernon	6 for 25 cents			
Nelsonville	30 for $1			
Newark	6 for 25 cents			
Niles	11 for 50 cents			
Piqua	6 for 25 cents			
Pomeroy	25 for $1			
Portsmouth	6 for 25 cents [34]	3		
Springfield	do.[23]			
Steubenville	11 for 50 cents			
Tiffin	6 for 25 cents [32]	2.1		
Toledo	do			3
Warren	11 for 50 cents			
Xenia	7 for 25 cents [33]			
Yellow Springs	6 for 25 cents [23]			
Youngstown	do.[23]			
Zanesville	do			
Indiana:				
Anderson	do			
East Chicago			2.5	
Elwood	6 for 25 cents			
Evansville	do			
Fort Wayne	do			
Gary	do			
Hammond			2.5	
Indianapolis	6 for 25 cents [23]		2.5	
Kokomo [35]	do		3.12	
Logansport	do			
Madison	do			3.12
Marion	do			
Muncie	do			
New Albany	do			
Richmond	do.[23]			
Terre Haute	do.[23]			
Vincennes	do			
Washington	do		2.5	
Whiting			2.5	
Illinois:				
Alton		2.5		
Aurora	6 for 25 cents			
Belvidere	25 for $1			
Bloomington	6 for 25 cents [36]			
Cairo	do.[23]			
Centralia	do	2.5		
Champaign	([37])			
Chicago [38]		3		
Chicago Heights		3		
Danville	11 for 50 cents [36]		2.5	
Decatur	12 for 50 cents [36]			
Dixon	6 for 25 cents			
Elgin	do			3.57
Galesburg	25 for $1			
Galva	do			
Joliet	6 for 25 cents			
Kankakee	25 for $1			
Kewanee	do			
Lincoln	6 for 25 cents [39]		2.5	
Lockport	do			
EAST NORTH CENTRAL—Continued.				
Illinois—Continued.		*Cents.*	*Cents.*	*Cents.*
Normal	6 for 25 cents			
Peoria	12 for 50 cents [36]			
Quincy	6 for 25 cents			
Rockford [40]	do.[23]		2	
Springfield	do			
Sterling	do			
Streator	do			
Urbana	([37])			
Michigan:				
Adrian	6 for 25 cents [32]			
Battle Creek	do			
Bay City	do			3
Benton Harbor	do			
Detroit	do.[41]			
Escanaba	do	[42] 2.5		
Gladstone	do	[42] 2.5		
Ironwood			3	
Jackson	6 for 25 cents			
Kalamazoo	do			
Lansing	do			
Manistee	11 for 50 cents			
Marine City	8 for 25 cents			
Menominee	6 for 25 cents	2.5		3.33
Morenci	do			
Mount Clemens	8 for 25 cents			
Muskegon	25 for $1			
Port Huron	8 for 25 cents			
Saginaw	6 for 25 cents		3.12	3.12
St. Joseph	do			
Sault St. Marie	do			
Wisconsin:				
Appleton	do			
Ashland		2.5		
Beloit	6 for 25 cents [23]		2	
Fond du Lac	24 for $1	3		
Green Bay	6 for 25 cents			
Hurley			3	
Janesville	6 for 25 cents [23]			
La Crosse		3	2.86	4.17
Madison		2.5		
Marinette	6 for 25 cents	2.5		3.33
Merrill	do.[23]			
Milwaukee	do.[41]			
Oshkosh				3.12
Racine				4.17
Sheboygan	6 for 25 cents			
Superior	do			
Wausau	do			
WEST NORTH CENTRAL.				
Minnesota:				
Breckenridge	22 for $1			
Dilworth	21 for $1		4	
Moorhead	do		4	
St. Cloud			3	4
Winona	52 for $2.50			
Iowa:				
Burlington	22 for $1			
Centerville	24 for $1			
Clear Lake	120 for $5			
Clinton	6 for 25 cents			2.5
Council Bluffs		2.5	3.33	
Dubuque		2.5		2.5
Fort Dodge	6 for 25 cents			
Fort Madison	25 for $1	2.5	2.5	
Iowa City	22 for $1			
Mason City	120 for $5			
Ottumwa	24 for $1		3	
Missouri:				
Cape Girardeau	25 for $1			
Hannibal	11 for 50 cents	2.5		
St. Joseph	12 for 50 cents [23]			
St. Louis		2.5		
Webb City	100 for $4.50			
North Dakota:				
Fargo	21 for $1		4	
Grand Forks	do			
Wahpeton	22 for $1			
South Dakota:				
Aberdeen	20 for 90 cents [43]			

STREET AND ELECTRIC RAILWAYS—RATES OF FARE WITHIN CITY LIMITS, BY GEOGRAPHIC DIVISIONS AND STATES—Continued.

[See notes at the end of this table, p. 221.]

Table 57—Contd.

DIVISION, STATE, AND CITY.	RATES OTHER THAN 5 CENTS.			
	Tickets—Number for amount indicated.	Children—Rate of fare.	School tickets—Rate of fare.	Working-men's tickets—Rate of fare.
WEST NORTH CENTRAL—Continued.				
Nebraska:		*Cents.*	*Cents.*	*Cents.*
Lincoln	6 for 25 cents [44]	2.5	3.33	
Omaha		2.5	3.33	
South Omaha		2.5	3.33	
Kansas:				
Atchison	25 for $1	2.08		
Hutchinson	6 for 25 cents			
Iola		2.5		
Manhattan	24 for $1			
SOUTH ATLANTIC.				
Delaware:				
New Castle				3
Wilmington	6 for 25 cents			
Maryland:				
Baltimore		3		
Cumberland	6 for 25 cents [36]		2	
Frederick	100 for $4			
Hagerstown	do			
Kensington	12 for 50 cents [45]			
District of Columbia:				
Washington	6 for 25 cents			
Virginia:				
Charlottesville		2.5		
Danville	6 for 25 cents		2.5	[46] 5
Lynchburg	do		3.12	
Newport News	do		[47] 2.5	[47] 2.5
Norfolk	do		2.5	2.5
Petersburg	do		2.5	2.5
Portsmouth	do			2.5
Radford	do		2.5	3
Richmond	do		2.5	2.5
Roanoke	25 for $1			
Staunton	6 for 25 cents			
Tazewell	20 for 75 cents			
West Virginia:				
Bluefield	6 for 25 cents		2.5	3
Clarksburg			3	
Fairmont	44 for $2		3	
Graham Station			2.5	3
Huntington	25 for $1			
Morgantown	do			
Parkersburg	6 for 25 cents [23]			2.5
Wheeling	do			
North Carolina:				
Asheville	do		2.5	
Charlotte	11 for 50 cents			
Fayetteville	6 for 25 cents [23]			
Greensboro	do	2.5	2.5	3.12
Raleigh	20 for 90 cents		2.5	
Salisbury	6 for 25 cents			
Wilmington	do			
Winston-Salem	do			3.12
South Carolina:				
Columbia	22 for $1			
Greenville	(48)			
Spartanburg			2.84	
Georgia:				
Gainesville	24 for $1 [36]			
Rome			2.5	
Savannah	21 for $1	2.5		
Valdosta	25 for $1 [49]			
Florida:				
Jacksonville			2.5	
Key West			2.5	
Pensacola	21 for $1			
St. Augustine	6 for 25 cents			
Tampa			2.5	
EAST SOUTH CENTRAL.				
Kentucky:				
Ashland	25 for $1			
Catlettsburg	do			
Frankfort	6 for 25 cents			
Lexington	do	2.5		
Louisville			2.5	
Maysville	25 for $1 [50]			
Owensboro	6 for 25 cents			
Paducah		2.5	2.5	
Somerset	25 for $1			
Tennessee:				
Bristol	6 for 25 cents [23]			
Chattanooga	23 for $1 [36]		3	
Clarksville	24 for $1	2.5		
Jackson	6 for 25 cents			
Knoxville			2.5	
Memphis	11 for 50 cents			
Nashville	50 for $2			
EAST SOUTH CENTRAL—Continued.				
Alabama:		*Cents.*	*Cents.*	*Cents.*
Birmingham			2.5	
Gadsden			3	
Mobile	22 for $1		3.5	
Montgomery	24 for $1		3.12	
Mississippi:				
Biloxi	do			
Columbus	25 for $1			
Greenville	6 for 25 cents		2.5	
Gulfport	24 for $1			
Laurel	22 for $1			
Long Beach	24 for $1			
Meridian	22 for $1 [51]			
Natchez	23 for $1 [52]		3.33	
Pass Christian	24 for $1			
Yazoo City	do	2.5		
WEST SOUTH CENTRAL.				
Arkansas:				
Fort Smith	25 for $1	2.5		
Hot Springs	6 for 25 cents [23]			
Little Rock		2.5	2.5	
Louisiana:				
Alexandria	20 for 50 cents			
Lake Charles			3	
Shreveport			2.5	
Oklahoma:				
Bartlesville	60 for $2.50 [53]	2.5		
Dewey	do.[53]	2.5		
El Reno			2.5	
McAlester	100 for $3.75	2		
Muskogee	100 for $4.50			
Oklahoma	6 for 25 cents		2.5	
Sapulpa			2.5	
Shawnee	100 for $4.25			
Tulsa		3		
Texas:				
Austin			2.5	
Beaumont			2.5	
Cleburne	11 for 50 cents	2.5		
Corpus Christi			2.5	
Dallas		2.5	2.5	
El Paso [54]		2.5	2.5	
Fort Worth	22 for $1	2.5		
Galveston		2.5	2.5	
Greenville			2.5	
Houston		2.5	2.5	
Laredo	24 for $1		2.5	
Marshall		2.5		
Paris	6 for 25 cents			
San Angelo			2.5	
San Antonio		2.5	2.5	
Waxahachie			3.33	
Wichita Falls	25 for $1		2.5	
MOUNTAIN.				
Montana:				
Great Falls			2.5	
Helena			2.5	
Missoula			3.75	
Idaho:				
Boise	11 for 50 cents		2.5	
Caldwell	do			
Nampa	do			
Wyoming:				
Cheyenne	25 for $1			
Colorado:				
Boulder	24 for $1	2.5		
Denver		2.5		
Durango		2.5		
Fort Collins		2.5		
Grand Junction	6 for 25 cents			
Greeley	21 for $1	2.78		
Manitou	40 for $1 [55]			
Pueblo	22 for $1	2.5		
New Mexico:				
Albuquerque	6 for 25 cents			
Arizona:				
Douglas	20 for 90 cents	2.5		
Phoenix			4	
Warren	8 for 25 cents			
Utah:				
Brigham	6 for 25 cents			
Logan	do.[21]	2.5		
Ogden	do			
Salt Lake City [56]	50 for $2		3	

STREET AND ELECTRIC RAILWAYS—RATES OF FARE WITHIN CITY LIMITS, BY GEOGRAPHIC DIVISIONS AND STATES—Continued.

[See notes at the end of this table.]

Table 57—Contd.	RATES OTHER THAN 5 CENTS.			
DIVISION, STATE, AND CITY.	Tickets—Number for amount indicated.	Children—Rate of fare.	School tickets—Rate of fare.	Working-men's tickets—Rate of fare.
PACIFIC.				
Washington:		*Cents.*	*Cents.*	*Cents.*
Bellingham	6 for 25 cents [23]		2.5	
Chehalis	50 for $2			
Everett [57]			2.5	
North Yakima	6 for 25 cents [21]		2.5	
Olympia	24 for $1		3.03	
Seattle	6 for 25 cents [25]		2.5	
Spokane	22 for $1			
Tacoma [57]	do		2.5	
Vancouver	50 for $1			
Oregon:				
Albany	50 for $2.25			
Eugene	do			
North Portland	50 for $2			
Portland [58]			3.33	
Salem	50 for $2.25			
PACIFIC—Continued.				
California:		*Cents.*	*Cents.*	*Cents.*
Bakersfield	110 for $5		2.5	
Eureka			2.5	
Exeter [59]			2.5	
Fresno			2.5	
Los Angeles [60]			2.5	
Petaluma	100 for $4.25 [61]			
Sacramento	22 for $1		2.5	
San Diego			2.5	
San Francisco			2.5	
San Jose [62]			2.5	
Santa Cruz [63]			2.5	
Stockton	23 for $1		2.5	

Referring to the rates of fare for children, pupils, and workingmen: A 2.5-cent rate indicates, as a rule, the sale of 10 tickets for 25 cents, though in some cases it is necessary to buy 20 tickets for 50 cents or 40 tickets for $1. In Beloit, Wis., 50 school tickets are sold for $1, making a 2-cent school fare.

The 2.08-cent rate indicates the sale of 12 tickets for 25 cents; the 2.78-cent rate, 9 tickets for 25 cents; the 2.86-cent rate, 35 tickets for $1; the 3-cent rate, a cash fare, or in some cases 40 tickets for $1.20 and in other cases 100 tickets for $3; the 3.03-cent rate, 30 tickets for $1; the 3.12-cent rate, 8 tickets for 25 cents in some cases and 16 tickets for 50 cents in others; the 3.33-cent rate, 15 tickets for 50 cents and 30 tickets for $1; the 3.57-cent rate, 7 tickets for 25 cents; the 4-cent rate, 25 tickets for $1; and the 4.17-cent rate, 6 tickets for 25 cents. In Plattsburg, N. Y., workingmen's tickets good for two 5-cent fares, one being outside of the city, are sold 10 for 50 cents.

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[1] And in cities and towns served by Brunswick & Yarmouth Street Railway, except that in Brunswick school tickets are 2 cents.
[2] And in cities and towns served by Lewiston, Augusta & Waterville Street Railway, except that in Brunswick and Topsham school tickets are 2 cents.
[3] Six-cent cash fare in winter.
[4] One hundred tickets (family), $4; 100 tickets (limited), $2.50.
[5] Cash fare, 6 cents; excursion summer tickets, 8 for 40 cents.
[6] Twenty tickets for 75 cents, or 6 tickets for 25 cents.
[7] Cash fare, 6 cents; tickets sold on basis of 5 per cent reduction.
[8] Cash fare, 6 cents.
[9] Cash fare, 6 cents; round-trip ticket, 10 cents.
[10] And for any city or town served by Bay State Street Railway Co.
[11] Mail carriers' tickets, 2½ cents.
[12] And in all cities served by Berkshire Street Railway.
[13] And in all cities served by Worcester Consolidated Street Railway Co.
[14] Workingmen's tickets good between various points of the system sold at different rates—30 for $1, 24 for 90 cents, 20 for 75 cents, 12 for 50 cents, 20 for 50 cents, and 6 for 25 cents.
[15] Fifty-two tickets (40 days), $2.08.
[16] For pupils attending schools at which tuition is charged in all cities served by the Connecticut Co.
[17] Brooklyn Bridge line, local railroad, 3 cents and 2½ cents.
[18] And in all cities served by Hoosick Falls Railroad Co.
[19] Mail carriers' tickets, 4½ cents.
[20] Joint rate over lines of two companies, 8 cents.
[21] Fifty tickets for $2.
[22] And all other cities served by New York & Stamford Railway Co.
[23] Twenty-five tickets for $1.
[24] And all cities served by Public Service Railway Co.
[25] Fifty-two tickets for $2.
[26] Thirty-three tickets for $1, good in city of McKeesport only.
[27] One hundred tickets for $4 (30 days).
[28] For 3 cents additional to 5-cent fare transfer tickets are issued.
[29] Sixty tickets for $2.
[30] Cash fare, 3 cents on tracks of the Cincinnati, Newport & Covington Railway Co. in Cincinnati.
[31] Twenty tickets for 50 cents on one road; 25 tickets for 50 cents on another road.
[32] Thirty tickets for $1.
[33] Thirty-three tickets for $1.
[34] Fifty-four tickets for $2.
[35] Mail carriers' tickets, 3½ cents.
[36] One hundred tickets for $4.
[37] One hundred tickets (60 days) for $4; 100 tickets (30 days) for $3.
[38] City employees' tickets, 4 cents.
[39] One hundred and fifty tickets, $5.
[40] Mail carriers' tickets, 3¾ cents; paper carriers' tickets, 2½ cents.
[41] On certain lines, 8 tickets for 25 cents.
[42] Under 12 years, free.
[43] One hundred tickets for $4.25.
[44] Ten tickets for 45 cents.
[45] Fifty tickets for $1.50.
[46] With return coupon.
[47] And for all cities served by Newport News & Old Point Railway & Electric Co.
[48] Tickets in books of 20 tickets sold for 90 cents when as many as 100 books are purchased by one person or firm.
[49] Two hundred and fifty tickets for $9.
[50] One hundred tickets for $3.
[51] Five hundred tickets for $20.
[52] One hundred tickets for $4.25.
[53] Employees' families, 60 tickets for $1.
[54] Rate of fare for clergy, 2½ cents.
[55] To residents.
[56] Company employees, 50 tickets for $1.25.
[57] Post-office employees, 4 cents.
[58] Police tickets, 1 cent; city employees, 3 cents; mail carriers, 3½ cents; coupon, 2½ cents.
[59] And for all cities served by Visalia Electric Railroad Co.
[60] And for all cities served by Pacific Electric Railway Co.
[61] Two hundred tickets for $7.50.
[62] And for all cities served by Peninsular Railway Co. and San Jose Railroad.
[63] Mail carriers' tickets, 2 cents; employees' families, 100-ride tickets, $2.50.

Freight, mail, and express business.—Table 58 gives the comparative statistics for freight, mail, and express business, by geographic divisions, for 1912, 1907, and 1902, and shows the growth in income therefrom and in number of companies engaged in the respective lines of business.

Table 58

DIVISION.[1]	Census.	TRAFFIC STATISTICS—FREIGHT, MAIL, AND EXPRESS: 1912, 1907, AND 1902.						
		Number of companies reporting financial data.	Freight.		Mail.		Baggage, express, and milk.	
			Number of companies reporting.	Income.	Number of companies reporting.	Income.	Number of companies reporting.	Income.
United States..	1912	975	406	$10,165,616	371	$723,640	381	$3,687,947
	1907	939	342	5,231,215	385	646,575	229	1,560,802
	1902	799	195	1,038,097	286	432,080	117	401,672
New England....	1912	91	43	826,646	59	105,118	38	404,179
	1907	118	39	286,385	75	103,368	36	261,332
	1902	137	29	178,276	72	69,460	27	32,633
Middle Atlantic..	1912	246	102	1,407,074	93	168,163	100	707,422
	1907	247	82	781,690	95	185,866	67	519,009
	1902	219	50	238,251	73	131,276	38	92,786
East North Central.	1912	222	114	3,492,543	90	172,862	121	1,759,893
	1907	220	100	2,131,237	93	141,888	69	544,870
	1902	177	55	301,692	61	91,652	32	239,526
West North Central.	1912	85	31	727,275	31	126,797	31	131,229
	1907	73	20	229,821	22	91,563	18	34,485
	1902	58	8	24,927	22	53,969	6	13,524
South Atlantic...	1912	107	41	$519,795	37	$60,310	33	$189,703
	1907	100	41	210,613	45	59,924	15	76,333
	1902	75	33	74,735	24	46,999	4	13,187
East South Central.	1912	45	14	171,760	14	15,749	7	102,851
	1907	40	17	154,110	17	13,535	3	1,115
	1902	34	6	38,233	8	8,419	2	5,524
West South Central.	1912	79	11	43,507	12	5,816	11	24,735
	1907	50	5	14,191	11	5,586	4	8,149
	1902	32	2	3,026	3	2,237	1	719
Mountain........	1912	40	16	126,632	8	4,951	12	50,883
	1907	28	8	128,232	2	2,722	2	1,503
	1902	18	1	50,544	5	3,165	1	34
Pacific..........	1912	60	34	2,850,384	27	63,874	28	317,052
	1907	63	30	1,294,936	25	42,123	15	114,006
	1902	49	11	128,413	18	24,903	6	3,739

[1] See page 25 (Central Electric Light and Power Stations) for states composing the several geographic divisions.

Two of the operating companies reporting in 1912, namely, the St. Louis and Belleville Electric Railway Co. of Illinois and the Bluff City Railway Co. of Mississippi, were engaged exclusively in freight traffic, and one, the first named, in 1907. Other exclusively electric freight roads not included in the general tabulation are the Chicago Tunnel Co. of Chicago and the Bingham Central Railway Co. of Utah.

CHAPTER VI.

CAPITALIZATION.

Basis of statistics.—The capitalization of street and electric railway companies consists of their capital stock and funded debt. The capital stock of many companies is divided into two classes of securities, common stock and preferred stock, which, as a rule, differ from each other only in the preference given the latter with respect to dividends and with respect to the distribution of assets in case of liquidation, when the preferred shares frequently have to be paid in full before the holders of the common shares receive any benefit of the distribution. The capital represented by funded debt takes a variety of forms, and the dividing line between funded debt and floating debt is not clearly defined. Funded debt is generally indebtedness evidenced by obligations issued in a group by a corporation, bearing a fixed rate of interest, and usually secured by a mortgage on property of the company. It may include mortgage bonds secured by a lien on the road and its franchises, income bonds which are a lien on revenue only, and miscellaneous obligations, such as collateral trust bonds, which comprise liens on specified property distinct from the road and its franchises.

The term "debentures," sometimes used, has no fixed meaning. It is generally used, however, with reference to corporate obligations bearing a fixed rate of interest which are not secured by mortgage. There are other classes of securities, notably receivers' certificates, which partake of the nature of funded indebtedness, as they take precedence over funded and so-called current liabilities, but as these are necessarily short lived and are soon paid or funded, they are not treated as part of the funded debt.

Ownership.—With the exception of the municipal railway of Monroe, La., and a few railways owned by individuals, all of the street and electric railways are operated under corporate ownership. The municipal railway of San Francisco was not completed until just before the close of 1912, and therefore was not included in the report. Neither do the statistics include data for one road at Bismarck owned and operated by the state of North Dakota in connection with the state capitol, and not included in the industry. The investments by owners other than incorporated companies, with a few exceptions, have been included in the total for common stock.

Capitalization.—Table 157 (p. 299) presents the statistics of track and capitalization, stock and funded debt, dividends, floating debt and mortgages, and net capitalization per mile of track, by geographic divisions and states, for 1912, 1907, and 1902. These statistics are summarized in Table 59.

STREET AND ELECTRIC RAILWAYS—CAPITALIZATION: 1912, 1907, AND 1902.

Table 59	1912	1907	1902	PER CENT OF INCREASE.[1]		
				1902–1912	1907–1912	1902–1907
Number of companies[2]	1,255	1,230	980	28.1	2.0	25.5
Operating companies	970	939	811	19.6	3.3	15.8
Lessor companies	285	291	169	68.6	−2.1	72.2
ALL COMPANIES.						
Capitalization	$4,708,568,141	$3,774,772,096	$2,308,282,099	104.0	24.7	63.5
Capital stock	2,379,346,313	2,097,708,856	1,315,572,960	80.9	13.4	59.5
Common	1,970,385,003	1,776,920,076	1,187,642,781	65.9	10.9	49.6
Preferred	408,961,310	320,788,780	127,930,179	219.7	27.5	150.8
Funded debt	2,329,221,828	1,677,063,240	992,709,139	134.6	38.9	68.9
Floating debt and mortgages	302,259,042	282,986,902	(3)	......	6.8	......
Dividends	70,992,218	54,485,274	33,039,171	114.9	30.3	64.9
Interest on funded and floating debt and mortgages	113,259,470	81,771,266	46,462,470	143.8	38.5	76.0
OPERATING COMPANIES.						
Capitalization	3,956,718,023	2,811,876,374	1,775,468,781	122.9	40.7	58.4
Capital stock	1,957,300,149	1,543,269,002	982,969,070	99.1	26.8	57.0
Common	1,606,071,539	1,270,590,322	893,735,791	79.7	26.4	42.2
Preferred	351,228,610	272,678,680	89,233,279	293.6	28.8	205.6
Funded debt	1,999,417,874	1,268,607,372	792,499,711	153.2	57.6	60.1
Floating debt and mortgages	285,503,649	225,210,178	(3)	......	26.8	......
Dividends	51,650,117	26,454,732	15,882,110	225.2	95.2	66.6
Interest on funded and floating debt and mortgages	98,025,338	63,740,744	38,085,911	157.4	53.8	67.4
LESSOR COMPANIES.						
Capitalization	751,850,118	962,895,722	532,813,318	41.1	−21.9	80.7
Capital stock	422,046,164	554,439,854	332,603,890	26.9	−23.9	66.7
Common	364,313,464	506,329,754	293,906,990	24.0	−28.0	72.3
Preferred	57,732,700	48,110,100	38,696,900	49.2	20.0	24.3
Funded debt	329,803,954	408,455,868	200,209,428	64.7	−19.3	104.0
Floating debt and mortgages	16,755,393	57,776,724	(3)	......	−71.0	......
Dividends	19,342,101	28,030,542	17,157,061	12.7	−31.0	63.4
Interest on funded and floating debt and mortgages	15,234,132	18,030,522	8,376,559	81.9	−15.5	115.2

[1] A minus sign (−) denotes decrease.

[2] Exclusive of 5 companies in 1912, 6 in 1907, and 7 in 1902, not represented by capitalization.

[3] Figures not available.

This table also includes, for 1912 and 1907, floating debt and mortgages, because the interest reported for 1912 covered all interest without distinguishing the class of security. The amount of floating debt and mortgages was not reported separately at the census of 1902.

The capitalization statistics apply to all but 5 of the 1,260 companies in 1912. In 1907, 6 of the 1,236 companies, and in 1902, 7 of the 987 companies, failed to report capitalization. The total amounts reported as the par value of common stock for each census include the cash investments of certain municipalities and individuals, but these investments are of such minor importance that the totals are not materially affected thereby.

The amount shown as interest on funded debt, floating debt, and mortgages is the amount charged as the deduction from income, and therefore does not represent the full interest charges, as some companies engaged in construction work charged part of the interest to construction account.

The increase in capitalization is but one of the many factors which should be considered as an indication of the increase in railway construction.

The par value of the outstanding capital stock and bonds reported for 1912 shows an increase of $933,796,045, or 24.7 per cent, over the total for 1907, while the track mileage represented by capitalization increased by 6,605.86 miles (from 33,833.54 in 1907 to 40,439.40 in 1912), or 19.5 per cent. The increase in capitalization reported for 1907 over that for 1902 was $1,466,489,997, or 63.5 per cent, and in track mileage owned, 11,597.15 miles, or 51.5 per cent. Of these two factors, the increase in miles of track furnishes the more satisfactory indication of the extent of the actual increase in electric railway development. Comparable with the increase in capitalization (24.7 per cent and 63.5 per cent, respectively, for the two 5-year periods) is the increase in revenue passenger traffic for the same periods, 28.3 per cent and 55.9 per cent, respectively, and the increase in gross income, 36.3 per cent and 71.6 per cent, respectively.

Table 60 shows the per cent distribution of the capitalization in 1912 and 1907, for all companies and for operating and lessor companies, according to class of securities and according to class of companies.

Common stock formed the largest proportion of the total outstanding capitalization at each of the two prior censuses, but the proportion decreased steadily until in 1912 it formed but 41.8 per cent of the total, while the funded debt increased until it formed 49.4 per cent in that year. Preferred stock, while forming but a small fraction of the total capitalization, increased from 5.6 per cent in 1902 to 8.8 per cent in 1912.

Table 60	Census.	CAPITALIZATION (PERCENTAGES BASED ON TABLE 59).				
		Per cent distribution.			Per cent of total.	
		Total.	Operating companies.	Lessor companies.	Operating companies.	Lessor companies.
Capitalization	1912	100.0	100.0	100.0	84.0	16.0
	1907	100.0	100.0	100.0	74.5	25.5
	1902	100.0	100.0	100.0	76.9	23.1
Capital stock	1912	50.6	49.5	56.1	82.3	17.7
	1907	55.6	54.9	57.6	73.6	26.4
	1902	56.9	55.4	62.4	74.7	25.3
Common	1912	41.8	40.6	48.4	81.5	18.5
	1907	47.1	45.2	52.6	73.2	26.8
	1902	51.3	50.4	54.9	75.3	24.7
Preferred	1912	8.8	8.9	7.7	85.9	14.1
	1907	8.5	9.7	5.0	85.0	15.0
	1902	5.6	5.0	7.5	69.8	30.2
Funded debt	1912	49.4	50.5	43.9	85.8	14.2
	1907	44.4	45.1	42.4	75.6	24.4
	1902	43.1	44.6	37.6	79.8	20.2

The foregoing does not take into account the capital invested in the form of real-estate mortgages and floating debt, which are generally grouped under current liabilities. The liabilities reported as floating debt and real-estate mortgages represent to a large degree funds used for carrying on the business of the companies, as well as the subscribed capital and bonds, and in a broad sense they constitute invested capital on which profits are realized in the form of interest; in fact, in many cases, funds for betterments and equipment are secured on short-term notes and carried as floating debt. These liabilities were not called for separately in the schedule for 1902, but in 1907 they amounted to $282,986,902 and in 1912 to $302,259,042. If these are included under "Capitalization," on the assumption that they are used for construction and equipment purposes or for operating capital, there is obtained a gross capitalization of $5,010,827,183 for 1912 and $4,057,758,998 for 1907, of which amounts floating debt and real-estate mortgages formed 6 per cent in 1912 and 7 per cent in 1907.

In order, however, to arrive at the net capitalization per mile of track, it is necessary to deduct the amount of stock and bonds of other electric railway companies and the stock and bonds held as treasury securities by the reporting companies. Furthermore, it is necessary to deduct the amount of investments in other securities and nonrailway properties to determine the net capitalization, inclusive of floating debt and real-estate mortgages, based on street and electric railways exclusively.

Table 61 shows the gross and net capitalization resulting from this arrangement of accounts and the net capitalization based upon street and electric railways exclusively.

Table 61

	CAPITALIZATION, INCLUDING FLOATING DEBT AND REAL-ESTATE MORTGAGES.		
	1912	1907	Per cent of increase.[1]
Capital stock	$2,379,346,313	$2,097,708,856	13.4
Common	1,970,385,003	1,776,920,076	10.8
Preferred	408,961,310	320,788,780	27.5
Funded debt	2,329,221,828	1,677,063,240	38.8
Floating debt and real-estate mortgages	302,259,042	282,986,902	6.7
Total	5,010,827,183	4,057,758,998	23.5
Stocks and bonds of other electric railway companies and treasury securities	360,105,164	237,896,093	51.4
Net capitalization	4,650,722,019	3,819,862,905	21.8
Investments in other securities and nonrailway properties	105,145,250	136,768,104	−23.1
Net capitalization based on street and electric railways:			
Inclusive of floating debt and real-estate mortgages	4,545,576,769	3,683,094,801	23.4
Per mile of track	112,405	107,942	4.1
Exclusive of floating debt and real-estate mortgages	4,243,317.727	3,400,107,899	24.8
Per mile of track	104,930	100,495	4.4

[1] A minus sign (—) denotes decrease.

The capitalization per mile of track is ascertained by dividing the net capitalization by the single-track mileage owned by the companies. The averages of $104,930 in 1912 and $100,495 in 1907 are comparable with $96,287 in 1902. The net capitalization per mile of track for the several divisions and states is given in Table 157 (p. 299) for 1912, 1907, and 1902. These data are summarized in Table 62.

Table 62

DIVISION.	NET CAPITALIZATION PER MILE OF TRACK.			
	1912	1907	1902	Per cent of increase:[1] 1902–1912
United States	$104,930	$100,495	$96,287	9.0
New England	61,577	54,724	45,441	35.5
Middle Atlantic	134.702	140,724	143,284	−6.0
East North Central	87,102	87,292	85,122	2.3
West North Central	97,807	102,948	106,125	−7.8
South Atlantic	125,409	112,013	114,289	9.7
East South Central	92,051	93,925	70,742	30.1
West South Central	93,272	100,083	67,405	38.3
Mountain	77,514	76,358	58,406	32.7
Pacific	145,428	102,272	82,761	75.7

[1] A minus sign (—) denotes decrease.

The average net capitalization per mile of track in the several geographic divisions shows a considerable variation during the five years 1907 to 1912. The West South Central division shows a decrease from $100,083 per mile to $93,272, or 6.8 per cent, while the capitalization in the Pacific division increased from $102,272 per mile in 1907 to $145,428 in 1912, or 42.2 per cent. As stated more fully in a later chapter, these averages are affected by varying proportions of expensive line construction and the inclusion to a greater or less extent of power plants, etc.

As before stated, capitalization is confined to the securities representing continuing or permanent investments—to capital stock and funded debt or bonds—the securities that represent the basic fund for the conduct of the business and on which its profits or dividends are calculated. Undoubtedly a part of the current liabilities of many street and electric railways should be considered as capitalization, but it is impossible to determine to what extent, and on account of the uncertainty existing in the current liability accounts and their unstable nature they are not included in capitalization statistics except as specially noted.

Table 63 is a summary of the statistics for capital stock, funded debt, and current liabilities for the three census years.

Table 63

	CAPITALIZATION AND CURRENT LIABILITIES.					
	1912	1907	1902	Per cent of increase.		
				1902-1912	1907-1912	1902-1907
Total	$5,315,258,541	$4,263,243.100	$2,560,427,534	107.6	24.7	66.5
Capitalization	4,708,568,141	3,774,772,096	2,308,282,099	104.0	24.7	63.5
Capital stock	2,379,346,313	2,097,708,856	1,315,572,960	80.9	13.4	59.5
Funded debt	2,329,221,828	1,677,063,240	992,709,139	134.6	38.9	68.9
Current liabilities	606,690,400	488,471,004	252,145,435	140.6	24.2	93.7
Floating debt and real-estate mortgages	302,259,042	282,986,902			6.8	
Floating debt	296,161,797	278,927,097	(1)		6.2	
Real-estate mortgages	6,097,245	4,059,805	(1)		50.2	
Other current liabilities	304,431,358	205,484,102			48.2	
Per cent of total:						
Capitalization	88.6	88.5	90.2			
Floating debt and real-estate mortgages	5.7	6.7	9.8			
Other current liabilities	5.7	4.8				

(1) Figures not available.

The slight variation in the proportion which current liabilities form of the total capitalization is noteworthy. The total of floating debt, real-estate mortgages, and other current liabilities formed only 9.8 per cent of the aggregate capitalization in 1902, 11.5 per cent in 1907, and 11.4 per cent in 1912. The funded debt has constantly increased until in 1912 it very nearly equaled the total amount of capital stock outstanding.

Capitalization and cost of construction.—In making their returns for the balance-sheet inquiry on the schedule, the majority of the companies inserted an amount for the cost of construction, equipment, and real estate that practically equaled the par value of their outstanding stock and bonds. There were, of course, many exceptions to this rule, due largely to the practice followed by some companies of reinvesting surplus earnings in plant and equipment without a corresponding increase in capitalization.

Table 64 compares the net capitalization reported by both operating and lessor companies with the cost of construction, equipment, and real estate, for 1912, 1907, and 1902.

Table 64 NET CAPITALIZATION AND COST OF CONSTRUCTION, EQUIPMENT, AND REAL ESTATE.

	1912	1907	1902	Per cent of increase.		
				1902-1912	1907-1912	1902-1907
Cost of construction, equipment, and real estate	$4,596,563,292	$3,537,668,708	$2,167,634,077	112.0	29.9	63.2
Net capitalization	4,243,317,727	3,400,107,899	2,117,619,302	100.4	24.8	60.6
Balance	353,245,565	237,560,809	50,014,775			
Per cent of cost of construction:						
Net capitalization	92.5	93.5	97.7			
Balance	7.5	6.5	2.3			

Holding companies.—In addition to the companies for which capital statistics have been presented, there are a large number of holding organizations, including both incorporated companies and unincorporated associations, organized to control the financial policies and management of operating and lessor companies. These companies have capital stock, or participating shares, and funded securities based upon the securities of the operating companies controlled by them. They may be divided into two classes: (*a*) incorporated companies duly organized as holding corporations; and (*b*) collateral trusts or voluntary associations managed by boards of trustees and having participating shares, generally both common and preferred, which are handled on the stock exchange on the same basis as the stock of incorporated companies. These shares in some cases have no stated par value, but in case of liquidation the preferred shares are generally rated at $100, and for statistical purposes, in connection with the statistics of incorporated companies, the shares of these associations have an assigned par value of $100.

There were 61 holding companies or organizations in 1912 identified largely with the street and electric railway industry. Table 65 shows the capital stock and funded debt of the two classes of companies.

Table 65 HOLDING COMPANIES—CAPITALIZATION: 1912.

	Number of companies.	Total capitalization.	Capital stock.			Funded debt.
			Total.	Common.	Preferred.	
Total	61	$1,122,031,503	$711,217,744	$473,013,858	$238,203,886	$410,813,759
Incorporated companies	51	959,921,320	589,617,361	415,615,853	174,001,508	370,303,959
Collateral trusts or voluntary associations	10	162,110,183	121,600,383	57,398,005	64,202,378	40,509,800
Per cent of total:						
Incorporated companies	83.6	85.5	82.9	87.9	73.0	90.1
Collateral trusts or voluntary associations	16.4	14.5	17.1	12.1	27.0	9.9

The collateral trusts or voluntary associations are the Chicago City & Connecting Railways of Illinois, and nine Massachusetts associations, namely, Boston Suburban Electric Cos., Boston & Worcester Electric Cos., Massachusetts Electric Cos., Massachusetts Northern Railways, New England Investment & Securities Co., New Hampshire Electric Railways, Southeastern Electric Cos., Springfield Railway Cos., and the Worcester Railways & Investment Co.

Table 66 shows the statistics of capitalization and the dividends and interest paid, for the holding companies in 1912 and 1907.

It is to be noted that the capitalization is based in part upon properties other than electric railways, and that in many cases the apportionment of investments between electric railway properties and nonrailway properties is a matter of estimate. The assets, as reported in 1912, include stocks and bonds and other permanent investments to the amount of $1,028,853,667, of which sum $764,475,457, or 74.3 per cent, represents, in the main, electric railways.

The income of the holding companies comes chiefly from dividends and interest on the securities of the controlled companies. A comparison of the dividends with the total par value of stock outstanding is misleading, since not all stock pays dividends.

Table 66 HOLDING COMPANIES.

	1912	1907	Per cent of increase.[1]
Number of companies	61	70	−12.9
Capitalization	$1,122,031,503	$954,695,373	17.5
Capital stock	711,217,744	663,361,158	7.2
Common	473,013,858	484,241,086	−2.3
Preferred	238,203,886	179,120,072	33.0
Funded debt	410,813,759	291,334,215	41.0
Floating debt	34,796,043	(2)	
Dividends	16,697,073	11,353,657	47.1
Interest	13,839,644	11,616,034	19.1
Total assets	1,234,805,590	1,048,407,343	17.8
Stocks and bonds of electric railway companies	764,475,457	[3] 763,858,954	25.8
Stocks and bonds of companies other than electric railways	196,427,753		
Treasury securities	22,089,133	10,600,200	108.4
Stocks	3,582,163	(2)	
Bonds	18,506,970	(2)	
Other permanent investments	67,950,457	183,183,377	−62.9
All other assets	183,862,790	90,764,812	102.6

[1] A minus sign (−) denotes decrease.
[2] Figures not available.
[3] Reported as stocks and bonds of other electric railway and light companies.

Table 67 analyzes the securities of holding companies with respect to dividends for 1912 and 1907.

Table 67

HOLDING COMPANIES—ANALYSIS OF DIVIDENDS.

	1912	1907
CAPITAL STOCK.		
Number of companies reporting	61	70
Number of companies declaring dividends	42	32
Per cent of total	68.9	45.7
Amount on which dividends were declared	$293,806,930	$285,629,301
Per cent of total capital stock	41.3	43.1
Amount of dividends	$16,697,073	$11,353,657
Average rate (per cent)	5.7	4.0
COMMON STOCK.		
Number of companies reporting	61	[1] 68
Number of companies declaring dividends	27	16
Per cent of total	44.3	23.5
Amount on which dividends were declared	$174,022,225	$156,882,450
Per cent of total common stock	36.8	32.4
Amount of dividends	$11,067,249	$6,187,389
Average rate (per cent)	6.4	3.9
PREFERRED STOCK.		
Number of companies reporting	36	38
Number of companies declaring dividends	25	25
Per cent of total	69.4	65.8
Amount on which dividends were declared	$119,784,705	$128,746,851
Per cent of total preferred stock	50.3	71.9
Amount of dividends	$5,629,824	$5,166,268
Average rate (per cent)	4.7	4.0

[1] Two companies reported no common stock.

The investments of these 61 holding companies include the securities wholly or in part of 230 operating companies, chiefly electric railways. In this connection Table 68 shows the income account of the holding companies by states, as reported for 1912, and Table 69 the balance sheet.

The total income reported by the 61 holding companies in 1912 amounted to $38,046,553. Of these 61 companies, 44 reported a surplus over deductions from income and dividends amounting to $6,169,329. There were, however, 17 companies which reported deficits for the year amounting to $831,768, leaving a net surplus of $5,337,561.

The total assets of holding companies as reported in 1912 amounted to $1,239,057,329, of which $764,475,457, or 61.7 per cent, was invested in stocks and bonds of electric railway companies. There were but 7 holding companies in New York. These 7 companies, however, controlled $444,450,716, or 35.9 per cent of the total investments. The profit and loss surplus for all companies reporting a surplus amounted to $25,684,620, but a number of companies showed a profit and loss deficit the aggregate of which amounted to $4,251,739, leaving $21,432,881 as the net surplus for all companies.

Table 68

HOLDING COMPANIES—INCOME ACCOUNT: 1912.

STATE.	Number of companies.	Number of operating companies.	Income.	Deductions from income.			Net income.	Dividends.	Surplus.
				Total.	Interest.	Miscellaneous.			
United States	61	230	$38,046,553	$16,011,919	$13,839,644	$2,172,275	$22,034,634	$16,697,073	$5,337,561
Illinois	6	55	4,532,199	1,661,030	1,571,014	90,016	2,871,169	2,129,552	741,617
Kentucky	4	6	1,239,953	81,452	33,733	47,719	1,158,501	1,121,838	36,663
Massachusetts	9	21	2,876,220	707,495	655,504	51,991	2,168,725	1,949,457	219,268
New York	7	37	14,754,346	7,545,644	6,787,504	758,140	7,208,702	2,912,044	4,296,658
Pennsylvania	17	51	9,418,657	2,815,212	2,043,733	771,479	6,603,445	6,478,227	125,218
Texas	4	11	1,715,980	513,686	433,625	80,061	1,202,294	982,635	219,659
All other states [1]	14	49	3,509,198	2,687,400	2,314,531	372,869	821,798	1,123,320	[2] 301,522

[1] Includes: California, 2; Georgia, 1; Michigan, 1; Minnesota, 1; Missouri, 2; New Hampshire, 1; New Jersey, 3; Ohio, 3.

[2] Deficit.

Table 69

HOLDING COMPANIES—BALANCE SHEET: 1912.

	United States.	Illinois.	Kentucky.	Massachusetts.	New York.	Pennsylvania.	Texas.	All other states.[1]
Number of companies	61	6	4	9	7	17	4	14
Total—Assets and liabilities	$1,239,057,329	$114,902,872	$32,847,254	$105,274,330	$444,450,716	$152,713,178	$42,625,128	$346,243,851
ASSETS.								
Stocks and bonds of electric railway companies	[2] 764,475,457	106,999,059	21,536,297	77,765,986	268,451,954	101,464,040	33,361,622	154,896,499
Stocks and bonds of companies other than electric railway, and other permanent investments	264,378,210	560,676	9,504,400	19,515,082	95,471,758	2,585,879	....	136,740,415
Treasury securities	22,089,133	1,260,000	582,800	700,300	16,098,320	561,970	844,000	2,041,743
Stocks	3,582,163	880,000	328,800	700,300	268,320	....	480,000	924,743
Bonds	18,506,970	380,000	254,000	....	15,830,000	561,970	364,000	1,117,000
Cash and current assets	117,934,765	3,186,735	1,189,340	3,406,689	47,551,741	10,242,465	7,975,681	44,382,114
Stock and bond discount, sinking and other special funds, and sundries	65,928,025	2,789,002	34,417	3,261,894	16,862,485	36,058,743	398,483	6,523,001
Deficit for companies showing a deficit	4,251,739	107,400	....	624,379	14,458	1,800,081	45,342	1,660,079
LIABILITIES.								
Capital stock	711,217,744	78,516,800	30,723,407	81,600,383	217,235,029	79,723,910	22,143,300	201,274,915
Common	473,013,858	37,508,200	19,943,487	42,398,005	162,547,792	76,595,870	10,143,300	123,877,204
Preferred	238,203,886	41,008,600	10,779,920	39,202,378	54,687,237	3,128,040	12,000,000	77,397,711
Funded debt	410,813,759	32,281,000	1,468,000	18,509,800	197,879,020	49,902,939	19,017,000	91,756,000
Floating debt	34,796,043	355,692	209,000	745,000	13,747,328	6,459,154	139,200	13,140,669
Reserves	1,337,544	33,375	118,550	103,940	....	355,245	378,950	347,484
Accounts payable	38,792,395	880,934	....	247,826	2,596,911	1,410,374	....	33,656,350
Interest and taxes due and accrued	4,246,693	466,877	7,716	151,635	2,787,499	198,329	93,411	541,226
Dividends due	1,330,286	562,500	119,375	207,493	270	257,312	....	183,336
Sundries	10,838,245	391,307	4,649	....	335,000	5,993,999	13,001	4,100,289
Surplus for companies showing a surplus	25,684,620	1,414,387	196,557	3,708,253	9,869,659	8,411,916	840,266	1,243,582
Net surplus	21,432,881	1,306,987	196,557	3,083,874	9,855,201	6,611,835	794,924	[3] 416,497

[1] Includes: California, 2; Georgia, 1; Michigan, 1; Minnesota, 1; Missouri, 2; New Hampshire, 1; New Jersey, 3; Ohio, 3.

[2] Includes $44,562,778 reported as cost of construction, equipment, and real estate.

[3] Net deficit.

Analysis of dividends and interest.—The extent to which the street and electric railways of the country afford a return on the capital invested in them is a matter of great interest not only to those directly connected with the industry but to the public as well. Table 70 presents an analysis of the statistics relating to dividends and interest, for operating and lessor companies combined, for 1912, 1907, and 1902.

Table 70

OPERATING AND LESSOR COMPANIES COMBINED—ANALYSIS OF DIVIDENDS AND INTEREST.

	1912	1907	1902	Per cent of increase.[1] 1902–1912	1907–1912	1902–1907
CAPITAL STOCK.						
Number of companies reporting	1,260	1,227	974	29.4	2.7	25.9
Number of companies declaring dividends	473	398	298	58.7	18.8	33.6
Per cent of total	37.5	30.7	30.6			
Amount outstanding	$2,379,346,313	$2,097,708,856	$1,315,572,960	80.9	13.4	59.5
Amount on which dividends were declared	$1,267,935,989	$1,012,929,430	$644,195,176	96.8	25.2	57.2
Per cent of total	53.3	48.3	49.0			
Amount of dividends	$70,992,218	$54,485,274	$33,039,171	114.9	30.3	64.9
Average rate (per cent)	5.6	5.4	5.1			
COMMON STOCK.						
Number of companies reporting	1,260	1,227	974	29.4	2.7	25.9
Number of companies declaring dividends	401	321	258	55.4	24.9	24.4
Per cent of total	31.8	26.2	26.5			
Amount outstanding	$1,970,385,003	$1,776,920,076	$1,187,642,781	65.9	10.9	49.6
Amount on which dividends were declared	$997,135,284	$805,210,600	$560,326,121	78.0	23.8	43.7
Per cent of total	50.6	45.3	47.9			
Amount of dividends	$58,759,715	$44,960,796	$28,737,887	104.5	30.7	56.5
Average rate (per cent)	5.9	5.6	5.1			
PREFERRED STOCK.						
Number of companies reporting	266	204	85	212.9	30.4	140.0
Number of companies declaring dividends	140	97	40	250.0	44.3	142.5
Per cent of total	52.6	47.5	47.1			
Amount outstanding	$408,961,310	$320,788,780	$127,930,179	219.7	27.5	150.8
Amount on which dividends were declared	$270,800,705	$207,718,830	$83,869,055	222.9	30.4	147.7
Per cent of total	66.2	64.8	67.7			
Amount of dividends	$12,232,503	$9,524,478	$4,301,284	184.4	28.4	121.4
Average rate (per cent)	4.5	4.6	5.1			
FUNDED DEBT.						
Number of companies reporting	974	992	781	24.7	−1.8	27.0
Per cent of total number	77.3	80.8	80.2			
Amount outstanding	$2,329,221,828	$1,677,063,240	$992,709,139	134.6	38.9	68.9
Floating debt and real-estate mortgages	$302,259,042	$282,986,902	(2)		6.8	
Amount of interest	$113,259,470	$81,771,266	$46,462,470	143.8	38.5	76.0
On funded debt	(2)	$71,468,788	$43,578,961			64.0
On floating debt and real-estate mortgages	(2)	$10,302,478	$2,883,509			257.3

[1] A minus sign (−) denotes decrease.

[2] Figures not available.

Of the 1,260 operating and lessor companies in 1912, 473, or 37.5 per cent, declared dividends on $1,267,935,989 capital stock, representing 53.3 per cent of the capital stock of all companies. The dividends declared aggregated $70,992,218, making the average rate of return 5.6 per cent on the stock of the companies declaring dividends. Dividends to the amount of $58,759,715 were paid on common stock by 401 companies, or 31.8 per cent of the total number, the stock on which dividends were paid constituting 50.6 per cent of the total common stock outstanding, the average rate of return being 5.9 per cent.

There were 266 companies reporting preferred stock, 140 of which paid dividends aggregating $12,232,503 on 66.2 per cent of the total stock of this class, the average rate of return being 4.5 per cent.

There were 974 companies reporting funded debt, and while the amount of interest on bonds was not called for separately from that on floating debt and mortgages, it is fairly safe to assume that interest was paid on substantially all of the $2,329,221,828 of funded debt outstanding.

It can not be assumed that the interest disbursements are applicable to the total funded debt, floating debt, and mortgages, aggregating $2,631,480,870, as in many cases bonds are used as collateral for floating debt, and in some instances interest was not paid, the companies in some cases being in the hands of receivers.

The average rate of dividends on common stock has increased slightly at each census since 1902, while the rate on preferred stock dividends has decreased in practically the same ratio.

Capitalization per mile of road of street and electric railways and steam roads.—Table 71 presents a comparison of the capitalization per mile of road of street and electric railways and steam roads. Since the Interstate Commerce Commission computes the relation of capitalization to trackage on the basis of line mileage or length of road, the figures for street and electric railways in Table 71 are also presented on this basis, although the general statistics for street and electric railways are based upon mileage of all tracks.

Table 71

CAPITALIZATION STATISTICS OF STREET AND ELECTRIC RAILWAYS AND STEAM ROADS: 1912.

	Total—Street and electric railways and steam roads combined.	Street and electric railways.	Steam roads.	Per cent of total.	
				Street and electric railways.	Steam roads.
Miles of road (or first track) represented	267,458.22	29,991.42	237,466.80	11.2	88.8
Total capitalization	$24,461,104,405	$4,708,568,141	$19,752,536,264	19.2	80.8
Stock	11,001,747,134	2,379,346,313	8,622,400,821	21.6	78.4
Funded debt	13,459,357,271	2,329,221,828	11,130,135,443	17.3	82.7
Investments in securities and nonrailway properties	5,130,186,028	465,250,414	4,664,935,614	9.1	90.9
Net amount not held by railway companies	19,330,918,377	4,243,317,727	15,087,600,650	22.0	78.0
Average amount per mile of road	72,277	141,484	63,535		

The investments in securities and nonrailway properties have been deducted from gross capitalization, but, as stated in the report of the Interstate Commerce Commission, "This assignment to other properties is one that can not be made with any considerable accuracy even by the reporting companies." Funded debt constitutes 56.3 per cent of the gross capitalization of the steam roads and 49.5 per cent of the electric railways. The funded debt of the street and electric railways averages $77,663 per mile of roads, as compared with $46,870 per mile for the steam road.

Capitalization of companies classified according to income from railway operations.—Table 72 presents statistics bearing on capitalization, for companies classed according to income from railway operations, for 1912, 1907, and 1902.

STREET AND ELECTRIC RAILWAYS—CAPITALIZATION OF OPERATING AND LESSOR COMPANIES COMBINED, CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS: CLASS A, $1,000,000 AND OVER; CLASS B, $250,000 BUT LESS THAN $1,000,000; CLASS C, LESS THAN $250,000.

Table 72

	1912	1907	1902	PER CENT OF INCREASE.[1]		
				1902–1912	1907–1912	1902–1907
Number of companies	1,260	1,230	980	28.6	2.4	25.5
Class A	283	240	132	114.4	17.9	81.8
Class B	217	214	133	63.2	1.4	60.9
Class C	760	776	715	6.3	−2.1	8.5
Miles of track owned[2]	40,439.40	33,833.54	22,389.04	80.6	19.5	51.1
Class A	20,976.16	15,346.60	8,386.91	150.1	36.7	83.0
Class B	9,544.20	8,336.78	4,877.23	95.7	14.5	70.9
Class C	9,919.04	10,150.16	9,124.90	8.7	−2.3	11.2
Capitalization	$4,708,568,141	$3,774,772,096	$2,308,282,099	104.0	24.7	63.5
Class A	3,251,909,701	2,443,813,815	1,493,396,343	117.8	33.1	63.6
Class B	825,806,276	672,081,782	378,056,241	118.4	22.9	77.8
Class C	630,852,164	658,876,499	436,829,515	44.4	−4.3	50.8
Capital stock	2,379,346,313	2,097,708,856	1,315,572,960	80.9	13.4	59.5
Class A	1,575,441,509	1,356,564,140	872,603,911	80.5	16.1	55.5
Class B	459,944,577	353,782,282	204,256,078	125.2	30.0	73.2
Class C	343,960,227	387,362,434	238,712,971	44.1	−11.2	62.3
Funded debt	2,329,221,828	1,677,063,240	992,709,139	134.6	38.9	68.9
Class A	1,676,468,192	1,087,249,675	620,792,432	170.1	54.2	75.1
Class B	365,861,699	318,299,500	173,800,163	110.5	14.9	83.1
Class C	286,891,937	271,514,065	198,116,544	44.8	5.7	37.0
Investments in securities and nonrailway property	465,250,414	374,664,197	152,513,997	205.1	24.2	145.7
Class A	309,929,016	212,395,041	128,387,757	141.4	45.9	65.4
Class B	87,403,903	72,184,390	13,010,932	571.8	21.1	454.8
Class C	67,917,495	90,084,766	11,115,308	511.0	−24.6	710.5
Net capitalization	4,243,317,727	3,400,107,899	2,155,768,102	96.8	24.8	57.7
Class A	2,941,980,685	2,231,418,774	1,365,008,586	115.5	31.8	63.5
Class B	738,402,373	599,897,392	365,045,309	102.3	23.1	64.3
Class C	562,934,669	568,791,733	425,714,207	32.2	−1.0	33.6
Dividends	70,992,218	54,485,274	33,039,171	114.9	30.3	64.9
Class A	58,115,534	47,935,519	28,890,831	101.2	21.2	65.9
Class B	9,425,960	4,623,123	2,752,125	242.5	103.9	68.0
Class C	3,450,724	1,926,632	1,396,215	147.1	79.1	38.0
PER MILE OF TRACK.						
Total capitalization	116,435	111,569	103,099			
Class A	155,029	159,241	178,063			
Class B	86,524	80,616	77,515			
Class C	63,600	64,913	47,872			
Capital stock	58,837	62,001	58,760			
Class A	75,106	88,395	104,044			
Class B	48,191	42,436	41,880			
Class C	34,677	38,163	26,161			
Funded debt	57,598	49,568	44,339			
Class A	79,923	70,846	74,019			
Class B	38,333	38,180	35,635			
Class C	28,923	26,750	21,712			
Net capitalization	104,930	100,495	96,287			
Class A	140,254	145,402	162,755			
Class B	77,367	71,958	74,847			
Class C	56,753	56,377	46,654			

[1] A minus sign (—) denotes decrease.

[2] Exclusive of track for which no capitalization was reported.

Table 73 gives the per cent distribution of the several items, by classified groups.

Table 73	Census.	CAPITALIZATION — PER CENT DISTRIBUTION (BASED ON TABLE 72).		
		Class A.	Class B.	Class C.
Number of companies	1912	22.5	17.2	60.3
	1907	19.5	17.4	63.1
	1902	13.5	13.6	73.0
Miles of track	1912	51.9	23.6	24.5
	1907	45.4	24.6	30.0
	1902	37.5	21.8	40.8
Capitalization	1912	69.1	17.5	13.4
	1907	64.7	17.8	17.5
	1902	64.7	16.4	18.9
Capital stock	1912	66.2	19.3	14.5
	1907	64.7	16.9	18.5
	1902	66.3	15.5	18.1
Funded debt	1912	72.0	15.7	12.3
	1907	64.8	19.0	16.2
	1902	62.5	17.5	20.0
Investments in securities and nonrailway property.	1912	66.6	18.8	14.6
	1907	56.7	19.3	24.0
	1902	84.2	8.5	7.3
Net capitalization	1912	69.3	17.4	13.3
	1907	65.6	17.6	16.7
	1902	63.3	16.9	19.8
Dividends	1912	81.9	13.3	4.9
	1907	88.0	8.5	3.5
	1902	87.4	8.3	4.2

It should be remembered that class A includes the companies operating in urban districts of highest density. The percentage of increase from 1907 to 1912 in capital stock reported by companies of class A was much lower than the percentage of increase in trackage, while the percentage of increase in funded debt was much greater. The trackage of this group increased 36.7 per cent; capital stock, 16.1 per cent; and funded debt, 54.2 per cent. In class C, or the group having an income of less than $250,000, there was a slight decrease in both trackage and capital stock, while the funded debt increased by 5.7 per cent.

It may be noted that while the average total and net capitalization per mile of track increased 4.3 per cent during the last five-year period, the increase was in funded debt only.

Capitalization of companies classified as "Elevated and subway" and "Surface."—Table 74 gives the capitalization statistics for the group of elevated and subway roads in comparison with all other roads, which are essentially surface and are so designated for 1912 and 1907.

The small group of elevated and subway systems represents the most expensive construction and the highest investment per mile of track for any class. It comprised 7 operating and 2 lessor companies in 1912, and 6 operating and 3 lessor companies in 1907. The Hudson tube system has been the chief factor in increasing the average net capitalization per mile of track. The increase in miles of single track for the group for the period 1907–1912 was 91.53 miles, but the increase in net capitalization was $149,251,535, or an average of over $1,630,000 per mile of track, if we charge the increase in capitalization entirely to the new trackage.

Table 74	CAPITALIZATION STATISTICS—ELEVATED AND SUBWAY, AND SURFACE.		
	1912	1907	Per cent of increase.[1]
Number of operating and lessor companies	1,260	1,230	2.4
Elevated and subway	9	9	....
Surface	1,251	1,221	2.5
Miles of track owned[2]	40,439.40	33,833.54	19.5
Elevated and subway	508.33	416.80	22.0
Surface	39,931.07	33,416.74	19.5
Capitalization	$4,708,568,141	$3,774,772,096	24.7
Elevated and subway	438,820,350	294,532,500	49.0
Surface	4,269,747,791	3,480,239,596	22.7
Capital stock	2,379,346,313	2,097,708,856	13.4
Elevated and subway	206,881,350	160,745,500	28.7
Surface	2,172,464,963	1,936,963,356	12.2
Funded debt	2,329,221,828	1,677,063,240	38.9
Elevated and subway	231,939,000	133,787,000	73.4
Surface	2,097,282,828	1,543,276,240	35.9
Investments in securities and nonrailway property	465,250,414	374,664,197	24.2
Elevated and subway	22,955,047	27,918,732	−17.8
Surface	442,295,367	346,745,465	27.6
Net capitalization	4,243,317,727	3,400,107,899	24.8
Elevated and subway	415,865,303	266,613,768	56.0
Surface	3,827,452,424	3,133,494,131	22.1
PER MILE OF TRACK.			
Total capitalization	116,435	111,569	4.4
Elevated and subway	863,259	706,652	22.2
Surface	106,928	104,147	2.7
Capital stock	58,837	62,001	−5.1
Elevated and subway	406,982	385,666	5.5
Surface	54,405	57,964	−6.1
Funded debt	57,598	49,568	16.2
Elevated and subway	456,277	320,986	42.1
Surface	52,523	46,183	13.7
Net capitalization	104,930	100,495	4.4
Elevated and subway	818,101	639,668	27.9
Surface	95,851	93,770	2.2

[1] A minus sign (—) denotes decrease.
[2] Exclusive of track for which no capitalization was reported.

Capitalization, by states.—The statistics as to capitalization, by states, are given in Table 157 (p. 299). The total for a state or geographic division is the aggregate capitalization of the operating and lessor companies credited thereto, each lessor company being credited to the state of the operating company. As a result, New York receives credit for the entire capitalization of the Hudson tube system, although 11.68 miles of the track is in New Jersey. Changes in organization have in some cases changed the states to which certain companies have been accredited at different censuses, but such changes are not important.

Diagram 3 (p. 193) shows graphically the capitalization, by states, for 1912, 1907, and 1902, for all states with more than $10,000,000 in 1912.

CHAPTER VII.

FINANCIAL OPERATIONS.

INTRODUCTION.

Form of accounting.—The reports of the financial transactions of street and electric railways conform to the system of accounting adopted by the United States Interstate Commerce Commission and by the American Electric Railway Accountants' Association. In cases where the method of accounting in use by a reporting company differed from the standard form, the differences, as a rule, could be readily adjusted. Adjustments in the statistics for 1907 and 1902, necessary to make them comparable with those for 1912, have been made where possible. The accounts, "Cleaning and sanding track" and "Removal of snow and ice," under "Operation of cars" in the 1907 report, have been transferred to "Maintenance of way;" "Hired equipment," formerly under "Operation of cars," has been transferred to "General expense;" and "Advertising and attractions," formerly under "General expense," now appears under "Traffic."

As a rule, the detailed statistics were obtained from bookkeeping entries. In only a few cases was it necessary to resort to estimates for the segregation of totals. In such cases the totals were distributed on a per cent basis of distribution derived from the combined totals of operating expense for 20 selected railways for the census of 1912.

Parks, summer hotels, theaters, and pleasure resorts operated by electric railways for the purpose of attracting traffic are treated as parts of the railway systems. The net income (or net expense) is included in the railway income account, and the cost or value of such properties is regarded as a part of the assets of the railways.

In the case of an electric railway operating a light and power plant that could not supply separate data for the two industries, the railway report included the gross income and expenses of the light and power plant, the cost of construction and equipment forming a part of the total reported for the railway company. In some cases the operating expense accounts of the light and power department and the railway department were merged in the detailed expense accounts, while in other cases the expenses of the light and power department were not included in the detailed accounts but were reported separately. The accounts are so presented as to show the total expenses of the light and power departments, whether included in the detailed accounts or reported separately.

In the case of a company carrying on other business in connection with the operation of an electric railway, the net income from the nonrailway industry and the total taxes and fixed charges were included in the income account, and the cost or value of the nonrailway plant in the balance sheet as "Other permanent investments." An exception to the rule was made in the case of two companies operating ferries, the ferry service being closely allied to the railway operations, and in the case of one company having a large office building not separable from terminal railway property. The income, expenses, etc., of these companies were therefore treated as part of the corresponding accounts of the railways.

References have been made to companies operated for less than a full year, companies operated for the purpose of holding franchises, companies operated in connection with a college or hotel during the college term or summer season, etc., and a few exclusively horse railroad companies, 47 companies in all, which under the present development of the industry are not in the same class with companies operated during the full year for traffic. These 47 companies are included in a group designated as "Miscellaneous." All other companies are classified according to whether or not they furnish light and power service in connection with their railway operations. The inclusion of these companies does not materially affect the financial results of operations for all companies, as shown by subsequent tables. The track and traffic statistics for this miscellaneous group for 1912, and for the part-time companies for 1907 and 1902, are as follows:

	TRACK AND TRAFFIC OF COMPANIES CLASSIFIED AS "MISCELLANEOUS."		
	1912	1907[1]	1902[1]
Number of companies	47	55	57
Miles of track	356.33	800.16	831.17
Number of revenue passengers	13,175,329	12,269,577	37,738,491
Car mileage	3,825,588	5,279,809	13,020,048

[1] Operated only a part of the year.

In addition to these 47 companies, there were a few companies whose operations, though largely confined to the summer or tourist season, assumed considerable proportions. As their organization expense, taxes, and other fixed charges were accruing and payable for the entire year, they were treated as operating the whole year and not included in the miscellaneous group.

Totals for states.—The totals reported for financial data for states do not represent the exact income, expense, etc., as the case may be, chargeable to the traffic within the state lines, but cover the traffic of the companies credited to the respective states. A considerable number of companies operate tracks in more than one state. Thus New York is credited with the traffic and financial data incident to 133.12 miles of track located outside the state, and the traffic and financial data applying to 173.03 miles of track located in Pennsylvania are included in the totals for adjoining states. The net trackage and income from railway operations chargeable thereto for the various states are given in Table 123 (p. 259).

INCOME ACCOUNT.

All income from railway operations originates with the operating companies, but a portion of it is paid as rentals to nonoperating lessor companies and is reported by them as income. This requires the preservation of the distinction between operating and lessor companies, and reports were therefore secured from the nonoperating lessor companies at the present census and in 1907. The statistics for lessor companies in 1902 were largely compiled from the rentals reported as paid by the operating companies and from information obtained from street railway journals and similar sources.

Gross income.—The gross income of the 1,260 operating and lessor companies was $621,535,884 in 1912, of which amount $35,144,521 was reported by the lessor companies as income from rentals paid by the operating companies. Excluding this duplication, the total income for all companies amounted to $586,391,363. This total includes a considerable income derived from sources other than railway operations, by both operating and lessor companies. One of the most important of these items is $7,182,933 reported as interest on bonds and dividends on stock of other electric railways. This involves a further duplication in the statistics of gross income as reported by all companies, since it represents the income from electric railway securities held by other operating railway companies. Table 75 gives the comparative statistics of the income of lessor and operating companies, for 1912, 1907, and 1902.

Table 75	INCOME OF OPERATING AND LESSOR COMPANIES COMBINED.					
	1912	1907	1902	Per cent of increase.[1]		
				1902–1912	1907–1912	1902–1907
Gross income	$621,535,884	$477,657,503	$276,643,526	124.7	30.1	72.7
Duplications	42,327,454	50,756,551	26,116,884	62.1	−16.6	94.3
Rentals from operating companies	35,144,521	47,500,933	26,116,884	34.6	−26.0	81.9
Income from interest on bonds and dividends on stock of other electric railway companies	7,182,933	3,255,618	(2)	......	120.6	......
Net income	579,208,430	426,900,952	250,526,642	131.2	35.7	70.4

[1] A minus sign (—) denotes decrease.

[2] Figures not available.

Such items as operating earnings, operating expenses, and net earnings from operation pertain exclusively to operating companies, and the gross income for these companies is shown in Table 76, while the income of the lessor companies and the net or condensed income of operating and lessor companies combined will be shown in later tables.

Table 76	GROSS INCOME OF OPERATING COMPANIES, BY SOURCE.					
ACCOUNT.	1912	1907	1902	Per cent of increase.		
				1902–1912	1907–1912	1902–1907
Gross income	$585,930,517	$429,744,254	$250,504,627	133.9	36.3	71.6
Operating revenues	567,511,704	418,187,858	247,553,999	129.2	35.7	68.9
Passenger	502,651,637	382,132,494	233,821,548	115.0	31.5	63.4
Parlor, chair, and special car	1,036,520	705,261	303,608	241.4	47.0	132.3
Freight	10,165,616	5,231,215	1,038,097	879.3	94.3	403.9
Mail	723,640	646,575	432,080	67.5	11.9	49.6
Baggage, express, and milk	3,687,947	1,560,802	401,672	818.1	136.3	288.6
Other transportation revenue	1,919,413	....	....	......	......	......
Sale of electric current	36,500,030	20,093,302	7,703,574	373.8	81.7	160.8
Other nontransportation revenue	10,826,901	7,818,209	3,853,420	181.0	38.5	102.9
Income from other sources	18,418,813	11,556,396	2,950,628	524.2	59.4	291.7
PER CENT OF GROSS INCOME.						
Operating revenues	96.9	97.3	98.8	......	......	......
Passenger	85.8	88.9	93.3	......	......	......
Parlor, chair, and special car	0.2	0.2	0.1	......	......	......
Freight, mail, baggage, and express	2.5	1.7	0.8	......	......	......
Sale of electric current	6.2	4.7	3.1	......	......	......
Other operating revenue	2.2	1.8	1.5	......	......	......
Income from other sources	3.1	2.7	1.2	......	......	......

A notable feature is the increase in income other than passenger, freight, mail, and express, and also in freight, mail, and express income as compared with passenger. Income other than that from passenger, parlor, chair, and special cars, and freight, mail, baggage, and express, formed 11.5 per cent of the gross income in 1912, as compared with 5.8 per cent in 1902, and income from freight, mail, baggage, and express 2.5 per cent in 1912, as compared with eight-tenths of 1 per cent in 1902.

Table 77 gives the gross income of the operating companies, by geographic divisions and states, for 1912, 1907, and 1902, the divisions and states being ranked according to income in 1912.

The rapid development of electric railways on the Pacific coast has advanced the Pacific division from sixth place in 1902 to fourth in 1912, while among the states California advanced from seventh place to sixth, Washington from seventeenth to thirteenth, and Oregon from twenty-eighth to seventeenth. The development in the West South Central division has also been large, the division having advanced from eighth place in 1907 and 1902 to seventh in 1912, chiefly because of growth in Texas, which advanced from twenty-fourth place in 1902 to sixteenth in 1912, and in Oklahoma, which, with no electric railways in 1902 and occupying thirty-seventh place in 1907, stood thirty-third in 1912. Other states which advanced in rank during the decade are Ohio, New Jersey, Michigan, Indiana, Virginia, West Virginia, Kansas, North Carolina, and Arkansas.

Table 77

DIVISION AND STATE.	GROSS INCOME OF OPERATING COMPANIES, BY GEOGRAPHIC DIVISIONS AND STATES.					
	1912	1907	1902	Rank.		
				1912	1907	1902
UNITED STATES	$585,930,517	$429,744,254	$250,504,627	......	......	......
GEOGRAPHIC DIVISIONS:						
Middle Atlantic	198,038,906	150,475,317	99,416,430	1	1	1
East North Central	139,260,473	101,418,112	55,887,241	2	2	2
New England	57,423,017	46,751,626	33,378,366	3	3	3
Pacific	56,293,175	33,576,347	13,553,639	4	5	6
West North Central	45,179,223	33,865,459	18,385,649	5	4	4
South Atlantic	41,368,967	29,604,986	15,164,235	6	6	5
West South Central	18,853,761	12,706,325	4,829,650	7	8	8
East South Central	17,562,259	13,646,689	6,556,640	8	7	7
Mountain	11,950,736	7,699,393	3,332,777	9	9	9
STATES:						
New York	123,523,376	91,685,673	60,881,780	1	1	1
Pennsylvania	56,194,047	45,706,986	30,357,727	2	2	2
Illinois	55,889,544	40,951,652	25,029,257	3	3	3
Ohio	40,706,038	31,274,901	16,599,851	4	4	5
Massachusetts	37,490,704	31,073,962	23,633,410	5	5	4
California	34,845,771	21,545,797	9,967,838	6	6	7
Missouri	21,240,533	18,082,732	10,734,692	7	7	6
New Jersey	18,321,483	13,082,658	8,176,923	8	8	9
Michigan	17,864,692	11,031,974	6,521,173	9	12	11
Delaware, Maryland, and District of Columbia	17,318,667	12,890,776	8,393,872	10	9	8
Indiana	16,142,075	11,496,768	3,813,076	11	11	13
Connecticut and Rhode Island	14,457,064	11,838,033	7,320,035	12	10	10
Washington	13,590,933	8,402,560	2,542,906	13	13	17
Minnesota	9,685,158	7,056,508	3,727,648	14	14	14
Wisconsin	8,648,124	6,662,817	3,923,884	15	15	12
Texas	8,514,403	4,857,997	1,547,846	16	18	24
Oregon	7,856,471	3,627,990	1,042,895	17	24	28
Iowa	7,452,454	4,391,140	2,403,834	18	23	18
Georgia	7,421,747	4,720,595	2,375,229	19	20	19
Virginia	7,247,056	5,401,415	1,667,022	20	17	22
Louisiana	6,998,131	5,994,975	2,910,244	21	16	16
Colorado	6,630,480	4,483,254	2,227,766	22	21	20
Kentucky	6,155,248	4,791,933	2,933,800	23	19	15
Tennessee	6,151,953	4,480,991	1,866,835	24	22	21
Alabama	4,344,668	3,467,476	1,497,351	25	25	25
West Virginia	3,708,197	2,588,725	1,102,171	26	27	27
Nebraska	3,618,337	2,744,104	1,148,994	27	26	26
Maine	3,593,617	2,293,197	1,571,562	28	28	23
Kansas	2,944,154	1,478,846	370,481	29	29	34
North Carolina	2,348,715	1,295,477	442,467	30	32	32
Florida	1,969,315	1,371,541	529,743	31	30	31
Arkansas	1,891,949	1,275,396	371,560	32	33	33
Oklahoma	1,449,278	577,957	....	33	37	......
South Carolina	1,355,270	1,336,457	653,736	34	31	29
New Hampshire	1,250,391	1,092,182	604,131	35	34	30
Montana	1,065,597	902,621	492,023	36	36	35
Mississippi	910,390	906,289	258,654	37	35	36
Vermont	631,241	454,252	249,228	38	38	37
North and South Dakota	238,587	112,129	....	39	39	......
All other states	4,254,659	2,313,518	612,988	......	......	......

The following table gives the per cent distribution of the number of companies and of the gross income, by geographic divisions, at the three censuses, the divisions being ranked according to gross income in 1912:

Table 78

DIVISION.	PER CENT OF TOTAL.					
	Number of companies.			Gross income.		
	1912	1907	1902	1912	1907	1902
United States	100.0	100.0	100.0	100.0	100.0	100.0
Middle Atlantic	25.2	26.3	27.4	33.8	35.0	39.7
East North Central	22.8	23.4	22.2	23.8	23.6	22.3
New England	9.3	12.6	17.1	9.8	10.9	13.3
Pacific	6.2	6.7	6.1	9.6	7.8	5.4
West North Central	8.7	7.8	7.3	7.7	7.9	7.3
South Atlantic	11.0	10.6	9.4	7.1	6.9	6.1
West South Central	8.1	5.3	4.0	3.2	3.0	1.9
East South Central	4.6	4.3	4.3	3.0	3.2	2.6
Mountain	4.1	3.0	2.3	2.0	1.8	1.3

It will be perceived that with respect to proportion of total gross income all of the Central, Southern, and Western divisions have advanced since 1902 at the expense of the Middle Atlantic and New England divisions.

Condensed income account of operating companies.—The condensed income account of operating companies, by geographic divisions and states, is given in Table 158 (p. 302) for 1912, 1907, and 1902. Table 79 is a consolidation of the income accounts of the operating companies, of the companies reporting a net income, and of the companies reporting a net deficit for 1912, 1907, and 1902.

This table may be regarded as representing all operating companies consolidated as a single unit, and those reporting net income and those reporting net deficit, respectively, consolidated as units. The per cent of increase for all companies for the decade 1902–1912 was the same for gross income and for operating expenses, namely, 133.9 per cent, but the ratio of increase in operating revenues was 129.2 per cent, a little less than that for operating expenses. For the first half of the decade the ratio of increase was higher for operating expenses than for operating revenues, but for the last half the per cent of increase for operating revenues was higher than for operating expenses. The increase during the decade in deductions from income, 146.3 per cent, was greater than for gross income or operating revenues, chiefly because of the increase in taxes, 167.8 per cent, and the increase in interest, 157.4 per cent; consequently the ratio of increase for net income during the decade, 102.3 per cent, was considerably lower than for gross income or operating revenues. The disbursements in the form of dividends have increased actually and proportionately with each census. In 1902 dividends declared formed 51.9 per cent of the net income; in 1907, 65.6 per cent; and in 1912, 83.4 per cent; and as a result there has been a progressive decrease in the net surplus for all operating companies.

A decrease in the surplus account does not necessarily reflect an unfavorable financial condition, since it may be the result of changes in financial policy or bookkeeping practice rather than of changes in traffic conditions. Charges for sinking funds and depreciation accounts, other than depreciation entered as a regular operating expense, are reported under miscellaneous deductions from income, and these deductions increased from $912,018, or 1.2 per cent of all deductions from income, in 1902, to $6,575,774, or 4.8 per cent of all deductions from income, in 1907, and to $13,285,584, or 7 per cent, in 1912.

Approximately one-third of the companies operated at a loss—that is, operating expenses and deductions from income or fixed charges exceeded gross income in the case of 34.7 per cent of the companies in 1912, 28.4

per cent in 1907, and 29.2 per cent in 1902. The gross income of the companies operating at a loss formed but 11.1 per cent of the gross income of all companies in 1912, as compared with 13.1 per cent in 1902.

STREET AND ELECTRIC RAILWAYS—CONDENSED INCOME ACCOUNT.

Table 79

ACCOUNT.	1912	1907	1902	PER CENT OF INCREASE.[1]		
				1902–1912	1907–1912	1902–1907
ALL OPERATING COMPANIES.						
Number of companies	975	939	799	22.0	3.8	17.5
Gross income	$585,930,517	$429,744,254	$250,504,627	133.9	36.3	71.6
Operating revenues	567,511,704	418,187,858	247,553,999	129.2	35.7	68.9
Operating expenses	332,896,356	251,309,252	142,312,597	133.9	32.5	76.6
Ratio of expenses to revenues (per cent)	58.7	60.1	57.5	......	......	......
Net operating revenue	$234,615,348	$166,878,606	$105,241,402	122.9	40.6	58.6
Miscellaneous income	18,418,813	11,556,396	2,950,628	524.2	59.4	291.7
Gross income less operating expenses	253,034,161	178,435,002	108,192,030	133.9	41.8	64.9
Deductions from income	191,123,408	138,094,716	77,595,053	146.3	38.4	78.0
Taxes	35,027,965	19,755,602	13,078,899	167.8	77.3	51.1
Interest	98,025,338	63,740,744	38,085,911	157.4	53.8	67.4
Rent of leased lines and terminals	44,784,521	48,022,596	25,518,225	75.5	−6.7	88.2
Miscellaneous deductions	13,285,584	6,575,774	912,018	1,356.7	102.1	621.0
Net income	61,910,753	40,340,286	30,596,977	102.3	53.5	31.8
Dividends	51,650,117	26,454,732	15,882,110	225.2	95.3	66.6
Surplus	10,260,636	13,885,554	14,714,867	−30.3	−26.1	−6.3
COMPANIES REPORTING NET INCOME.						
Number of companies	637	672	566	12.5	−5.2	18.7
Gross income	$520,898,845	$334,366,519	$217,753,909	139.2	55.8	53.6
Operating revenues	505,201,891	324,630,690	216,370,744	133.5	55.6	50.0
Operating expenses	288,468,430	190,734,840	121,264,907	137.9	51.2	57.3
Ratio of expenses to revenues (per cent)	57.1	58.7	56.0	......	......	......
Net operating revenue	$216,733,461	$133,895,850	$95,105,837	127.9	61.9	40.8
Miscellaneous income	15,696,954	9,735,829	1,383,165	1,034.9	61.2	603.9
Gross income less operating expenses	232,430,415	143,631,679	96,489,002	140.9	61.8	48.9
Deductions from income	161,612,494	92,429,698	62,136,318	160.1	74.8	48.8
Taxes	31,919,382	15,974,845	11,354,983	181.1	99.8	40.7
Interest	79,388,657	49.161,890	30,917,983	156.8	61.5	59.0
Rent of leased lines and terminals	38,870,160	21,315,583	19,157,541	102.9	82.3	11.3
Miscellaneous deductions	11,434,295	5,977,380	705,811	1,520.0	91.3	746.9
Net income	70,817,921	51,201,981	34,352,684	106.1	38.3	49.1
Dividends	51,592,632	26,444,987	15,775,079	227.1	95.1	67.6
Surplus	19,225,289	24,756,994	18,577,605	3.5	−22.4	33.3
COMPANIES REPORTING NET DEFICIT.						
Number of companies	338	267	233	45.1	26.6	14.6
Gross income	$65,031,672	$95,377,735	$32,750,718	98.7	−31.8	191.2
Operating revenues	62,309,813	93,557,168	31,183,255	99.8	−33.4	200.0
Operating expenses	44,427,926	60,574,412	21,047,690	111.1	−26.7	187.8
Ratio of expenses to revenues (per cent)	71.3	64.7	67.5	......	......	......
Net operating revenue	$17,881,887	$32,982,756	$10,135,565	76.4	−45.8	225.4
Miscellaneous income	2,721,859	1,820,567	1,567,463	73.6	49.5	16.1
Gross income less operating expenses	20,603,746	34,803,323	11,703,028	76.1	−40.8	197.4
Deductions from income	29,510,914	45,665,018	15,458,735	90.9	−35.4	195.4
Taxes	3,108,583	3,780,757	1,723,916	80.3	−17.8	119.3
Interest	18,636,681	14,578,854	7,167,928	160.0	27.8	103.4
Rent of leased lines and terminals	5,914,361	26,707,013	6,360,684	−7.0	−77.9	319.9
Miscellaneous deductions	1,851,289	598,394	206,207	797.8	209.4	190.2
Net deficit	*8,907,168*	*10,861,695*	*3,755,707*	137.2	−18.0	189.2
Dividends	57,485	9,745	107,031	−46.3	489.9	−90.9
Total deficit	*8,964,653*	*10,871,440*	*3,862,738*	132.1	−17.5	181.4
PER CENT OF TOTAL.						
Number of companies	100.0	100.0	100.0	......	......	......
Companies reporting net income	65.3	71.6	70.8	......	......	......
Companies reporting net deficit	34.7	28.4	29.2	......	......	......
Gross income	100.0	100.0	100.0	......	......	......
Companies reporting net income	88.9	77.8	86.9	......	......	......
Companies reporting net deficit	11.1	22.2	13.1	......	......	......
Operating expenses	100.0	100.0	100.0	......	......	......
Companies reporting net income	86.7	75.9	85.2	......	......	......
Companies reporting net deficit	13.3	24.1	14.8	......	......	......
Deductions from income	100.0	100.0	100.0	......	......	......
Companies reporting net income	84.6	66.9	80.1	......	......	......
Companies reporting net deficit	15.4	33.1	19.9	......	......	......

[1] A minus sign (—) denotes decrease.

Table 80 shows the per cent distribution of gross income according to the several objects for which the income was employed. It gives the distribution for all companies, for companies operating at a profit, and for those operating at a loss.

It will be seen that in the case of the companies operating at a loss approximately two-thirds of the gross income was absorbed by operating expenses, or an average of 68.3 per cent in 1912, as compared with an average of 55.4 per cent for the companies reporting a net income; and that interest charges, in the case of companies operating at a loss, consumed 28.7 per cent of the gross income, as compared with 15.2 for the companies reporting a profit. Similar conditions are shown for 1907 and 1902, except that in 1907 rentals paid for leased lines and terminals consumed a much larger share of the gross income, reaching 28 per cent in 1907.

Table 80 PER CENT DISTRIBUTION, BY ACCOUNTS, OF GROSS INCOME OF OPERATING COMPANIES (BASED ON TABLE 79).

ACCOUNT.	Total—All companies.			Companies reporting net income.			Companies reporting net deficit.[1]		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Gross income	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Operating revenues	96.9	97.3	98.8	97.0	97.1	99.4	95.8	98.1	95.2
Miscellaneous income	3.1	2.7	1.2	3.0	2.9	0.6	4.2	1.9	4.8
Operating expenses	56.8	58.5	56.8	55.4	57.0	55.7	68.3	63.5	64.3
Deductions from income	32.6	32.1	31.0	31.0	27.6	28.5	45.4	47.9	47.2
Taxes	6.0	4.6	5.2	6.1	4.8	5.2	4.8	4.0	5.3
Interest	16.7	14.8	15.2	15.2	14.7	14.2	28.7	15.3	21.9
Rent of leased lines and terminals	7.6	11.2	10.2	7.5	6.4	8.8	9.1	28.0	19.4
Miscellaneous deductions	2.3	1.5	0.4	2.2	1.8	0.3	2.8	0.6	0.6
Net income or net deficit[1]	10.6	9.4	12.2	13.6	15.3	15.8	*13.7*	*11.4*	*11.5*
Dividends	8.8	6.2	6.3	9.9	7.9	7.2	0.1	(2)	0.3
Surplus or deficit[1]	1.8	3.2	5.9	3.7	7.4	8.5	*13.8*	*11.4*	*11.8*

[1] Italics indicate deficit. [2] Less than one-tenth of 1 per cent.

Table 81 gives comparative statistics for companies showing a net deficit for 1912, 1907, and 1902, by geographic divisions.

Table 81 CONDENSED INCOME ACCOUNT OF OPERATING COMPANIES REPORTING NET DEFICIT, BY GEOGRAPHIC DIVISIONS: 1912, 1907, AND 1902.

DIVISION.	Census.	Number of companies.	Gross income.	Operating expenses.	Deductions from income.	Net deficit.
United States	1912	338	$65,031,672	$44,427,926	$29,510,914	*$8,907,168*
	1907	267	95,377,735	60,574,412	45,665,018	*10,861,695*
	1902	233	32,750,718	21,047,690	15,458,735	*3,755,707*
North Atlantic (New England and Middle Atlantic).	1912	129	33,987,536	23,053,531	16,415,848	*5,481,843*
	1907	120	69,736,683	42,063,080	34,004,750	*6,331,147*
	1902	140	12,107,564	8,709,588	5,373,376	*1,975,400*
North Central	1912	84	19,532,630	12,657,729	8,419,496	*1,544,595*
	1907	75	14,358,999	10,055,401	6,555,632	*2,252,034*
	1902	44	18,790,867	10,820,471	9,395,631	*1,425,235*
South Atlantic	1912	34	1,796,707	1,527,732	578,372	*309,397*
	1907	26	1,122,509	961,428	383,222	*222,141*
	1902	22	1,092,183	859,977	464,662	*232,456*
South Central	1912	43	1,792,572	1,549,959	609,119	*366,506*
	1907	18	1,657,142	1,309,957	596,836	*249,651*
	1902	14	465,130	387,844	133,094	*55,808*
Western (Mountain and Pacific).	1912	48	7,922,227	5,638,975	3,488,079	*1,204,827*
	1907	28	8,502,402	6,184,546	4,124,578	*1,806,722*
	1902	13	294,974	269,810	91,972	*66,808*

The bulk of the deficit comes from companies in the New England and Middle Atlantic divisions, combined as the North Atlantic for comparative purposes. In 1912 these divisions furnished 61.5 per cent of the total deficit, as compared with 58.3 per cent in 1907 and 52.6 per cent in 1902.

Table 82 gives the condensed income account for all operating companies, for companies reporting "net income," and for companies reporting "net deficit," by geographic divisions, for 1912.

For the country as a whole, 637 companies, or 65.3 per cent of the total number, show net profits to the amount of $70,817,921, and 338 companies, or 34.7 per cent of the total number, show net deficits to the amount of $8,907,168, making a net profit balance of $61,910,753 for all companies. In the Middle Atlantic division 41.1 per cent of the companies, with 15.6 per cent of the gross income, reported net deficits aggregating $5,191,923, and in the Mountain division more than half of the companies (52.5 per cent), with 14.1 per cent of the gross income, reported net deficits. On the other hand, in the West North Central division but 25.9 per cent of the companies, with 2.1 per cent of the gross income, reported net deficits.

Table 82 CONDENSED INCOME ACCOUNT OF ALL OPERATING COMPANIES, OF COMPANIES REPORTING NET INCOME, AND OF COMPANIES REPORTING NET DEFICIT: 1912.

DIVISION AND CLASS.	Number of companies.	Gross income.	Operating expenses.	Deductions from income.	Net income or net deficit.
ALL COMPANIES.					
United States	975	$585,930,517	$332,896,356	$191,123,408	$61,910,753
New England	91	57,423,017	37,316,197	14,062,569	6,044,251
Middle Atlantic	246	198,038,906	108,656,704	75,286,805	14,095,397
East North Central	222	139,260,473	78,747,118	45,893,986	14,619,369
West North Central	85	45,179,223	27,363,397	11,225,491	6,590,335
South Atlantic	107	41,368,967	21,591,731	13,277,195	6,500,041
East South Central	45	17,562,259	9,867,378	4,727,566	2,967,315
West South Central	79	18,853,761	10,390,837	5,139,540	3,323,384
Mountain	40	11,950,736	6,426,225	3,729,066	1,795,445
Pacific	60	56,293,175	32,536,769	17,781,190	5,975,216
COMPANIES REPORTING NET INCOME.					
United States	637	520,898,845	288,468,430	161,612,494	70,817,921
New England	63	54,297,594	34,842,387	13,121,036	6,334,171
Middle Atlantic	145	167,176,793	88,076,983	59,812,490	19,287,320
East North Central	160	120,662,129	66,814,733	37,775,198	16,072,198
West North Central	63	44,244,937	26,638,053	10,924,783	6,682,101
South Atlantic	73	39,572,260	20,063,999	12,698,823	6,809,438
East South Central	28	16,617,579	9,144,231	4,373,480	3,099,868
West South Central	53	18,005,869	9,564,025	4,884,507	3,557,337
Mountain	19	10,269,050	5,014,622	3,106,129	2,148,299
Pacific	33	50,052,634	28,309,397	14,916,048	6,827,189
COMPANIES REPORTING NET DEFICIT.					
United States	338	65,031,672	44,427,926	29,510,914	*8,907,168*
New England	28	3,125,423	2,473,810	941,533	*289,920*
Middle Atlantic	101	30,862,113	20,579,721	15,474,315	*5,191,923*
East North Central	62	18,598,344	11,932,385	8,118,788	*1,452,829*
West North Central	22	934,286	725,344	300,708	*91,766*
South Atlantic	34	1,796,707	1,527,732	578,372	*309,397*
East South Central	17	944,680	723,147	354,086	*132,553*
West South Central	26	847,892	826,812	255,033	*233,953*
Mountain	21	1,681,686	1,411,603	622,937	*352,854*
Pacific	27	6,240,541	4,227,372	2,865,142	*851,973*

Condensed income account of nonoperating lessor companies.—There were 285 nonoperating lessor companies in 1912, as compared with 291 in 1907 and 170 in 1902, but 12 of these companies in 1902 did not furnish financial reports. While all but a small portion of the income of these companies was paid as rental by other operating companies, its distribution is a matter of importance. Table 83 gives the income account of these companies for 1912, 1907, and 1902.

The nonoperating companies reported a gross income of $35,605,367 in 1912, as compared with $47,913,249 in 1907 and $26,138,899 in 1902.

The decrease in the financial accounts for 1912, as compared with 1907, is due largely to changes in the status of a few roads. In 1907 the Metropolitan Street Railway Co., the Third Avenue Railway Co., the Second Avenue Railroad Co., and the Central Park, North and East River Railroad Co., of New York City, were nonoperating lessor companies, with an aggregate gross income of $8,735,171, but in 1912 they were operating companies, the first constituting a part of the New York Street Railways. In Chicago 6 lessor companies in 1907, with incomes aggregating $1,767,445, were constituent elements of the Chicago Railways Co., an operating company, in 1912. These changes alone involve an amount equal to 85 per cent of the shrinkage in lessor company revenues. In some cases the operating company is charged with the payment of the taxes for the lessor company, as well as interest on its bonds and other rental considerations, and the taxes are included along with the taxes of the operating company, instead of being entered as a part of the rental and charged against the income of the lessor company as an expense of that company. Variance in methods of handling these accounts in the reports for different censuses probably accounts for a portion of the difference. In Pennsylvania there was a shrinkage in income of lessor companies from $13,937,422 in 1907 to $9,650,103 in 1912. There were 138 lessor companies in Pennsylvania in 1912, and the shrinkage is distributed among a large number of those companies.

Table 83 CONDENSED INCOME ACCOUNT OF NONOPERATING LESSOR COMPANIES.

	1912	1907	1902	Per cent of increase.[1] 1902–1912	1907–1912	1902–1907
NUMBER OF COMPANIES.						
United States	285	291	[2] 158	80.4	−2.1	84.2
Geographic divisions:						
New England	28	27	29	−3.4	......	......
Middle Atlantic	190	203	[2] 113	68.1	......	......
East North Central	31	43	12	158.3	......	......
West North Central	5	4	1	400.0	......	......
South Atlantic	16	10	2	700.0	......	......
East South Central	1	......	......	......	......	......
West South Central	4	1	......	......	......	......
Mountain	2	1	1	100.0	......	......
Pacific	8	2	......	......	......	......
INCOME ACCOUNT.						
Gross income	$35,605,367	$47,913,249	$26,138,899	36.2	−25.7	83.3
Rentals from operating companies	35,144,521	47,500,933	26,116,884	34.6	−26.0	81.9
Miscellaneous income	460,846	412,316	22,015	......	11.8	......
Deductions from income	16,090,372	19,465,984	8,779,294	83.2	−17.3	121.7
Interest	15,234,132	18,030,522	8,376,559	81.9	−15.5	115.2
Taxes and miscellaneous (maintenance of organization, etc.)	856,240	1,435,462	402,735	112.6	−40.4	256.4
Net income	19,514,995	28,447,265	17,359,605	12.4	−31.4	63.9
Dividends	19,342,101	28,030,542	17,157,061	12.7	−31.0	63.4
Surplus	172,894	416,723	202,544	−14.6	−58.5	105.7
PER CENT OF GROSS INCOME.						
Rentals from operating companies	98.7	99.1	99.9	......	......	......
Miscellaneous income	1.3	0.9	0.1	......	......	......
Deductions from income	45.2	40.6	33.6	......	......	......
Interest	42.8	37.6	32.1	......	......	......
Taxes and miscellaneous	2.4	3.0	1.5	......	......	......
Net income	54.8	59.4	66.4	......	......	......
Dividends	54.3	58.5	65.6	......	......	......
Surplus	0.5	0.9	0.8	......	......	......

[1] A minus sign (−) denotes decrease.
[2] Exclusive of 12 companies which failed to furnish financial information.

The deductions from income for the lessor companies were relatively much greater in 1912 than in 1907, and in 1907 than in 1902. The increase is chiefly found in the disbursements for interest, which formed 42.8 per cent of the gross income in 1912, as compared with 32.1 per cent in 1902. Conversely, the proportion of gross income remaining as net income decreased from 66.4 per cent in 1902 to 54.8 per cent in 1912, and the disbursements in dividends from 65.6 per cent to 54.3 per cent. Of course, there is no necessity for the lessor companies to retain any considerable amounts as surplus.

The income account in detail for the nonoperating lessor companies, by states, for 1912, 1907, and 1902, is given in Table 159 (p. 305).

Condensed income account of operating and lessor companies combined.—A combination of the income accounts of the operating and lessor companies is given in Table 84 to show the aggregates for all street and electric railways of the United States, the duplications due to rentals paid by the operating companies to the lessor companies being eliminated.

Table 84 CONDENSED INCOME ACCOUNT OF OPERATING AND LESSOR COMPANIES COMBINED.

ACCOUNT.	1912	1907	1902	Per cent of increase.[1] 1902–1912	1907–1912	1902–1907
Number of companies	1,260	1,230	957	31.7	2.4	28.5
Gross income	$586,391,363	$430,156,570	$250,526,642	134.1	36.3	71.7
Operating revenues	567,511,704	418,187,858	247,553,999	129.2	35.7	68.9
Operating expenses	332,896,356	251,309,252	142,312,597	133.9	32.5	76.6
Net operating revenue	234,615,348	166,878,606	105,241,402	122.9	40.6	58.6
Miscellaneous income	18,879,659	11,968,712	2,972,643	535.1	57.8	302.6
Gross income less operating expenses	253,495,007	178,847,318	108,214,045	134.3	41.7	65.3
Deductions from income	172,069,259	110,059,767	60,856,122	182.7	56.3	80.8
Interest	113,259,470	81,771,266	46,462,470	143.8	38.5	77.0
Miscellaneous, including taxes	[2] 58,809,789	[2] 28,288,501	14,393,652	308.6	107.9	96.5
Net income	81,425,748	68,787,551	47,357,923	71.9	18.4	45.3
Dividends	70,992,218	54,485,274	33,039,171	114.9	30.3	64.9
Surplus	10,433,530	14,302,277	14,318,752	−27.1	−27.1	−0.1
PER CENT OF GROSS INCOME.						
Operating revenues	96.8	97.2	98.8	......	......	......
Miscellaneous income	3.2	2.8	1.2	......	......	......
Operating expenses	58.3	58.4	56.8	......	......	......
Deductions from income	27.8	25.6	24.3	......	......	......
Interest	17.5	19.0	18.6	......	......	......
Miscellaneous, including taxes	10.3	6.6	5.7	......	......	......
Net income	13.9	16.0	18.9	......	......	......
Dividends	12.1	12.7	13.2	......	......	......
Surplus	1.8	3.3	5.7	......	......	......

[1] A minus sign (−) denotes decrease.
[2] Includes rentals paid to other operating companies, steam railroads, municipalities for subways, etc.

The rentals reported by the lessor companies as received do not, in all cases, agree with the amounts reported as paid for rental by the operating companies, the discrepancy being due primarily to differences in methods of accounting. In some cases not all of the rental reported by the lessee company was paid, but the full amount of the obligation was reported by the lessee company and the cash payments by the lessor company. In other cases the reports of the related operating and lessor companies did not cover the same period of time. To make the figures comparable the rentals received by the lessor companies are deducted from the income side of the account and a like amount from the fixed charges. The excess of rentals paid by the operating companies over rentals received by the lessor companies represents rentals paid to companies other than the lessor street and electric railway companies and includes rentals paid other operating companies, rentals paid to municipalities for subways, as in New York and Boston, rentals for track leased from steam railroads, etc. The amount paid by operating companies for track leased from other operating companies is a duplication that can not be eliminated, but this amount is not relatively large. In 1912 the trackage leased by operating companies from other operating companies constituted but 1.3 per cent of the total trackage leased from electric railway companies.

The proportion of the gross income disbursed in dividends was necessarily higher for all companies combined than for operating companies alone, on account of the elimination of the duplications due to rentals and to the disbursement by the lessor companies of more than half of their income in the form of dividends.

The income account for operating and lessor companies combined is presented, by states, in Table 160 (p. 306) for all states for which the statistics of lessor companies are given in Table 159.

Condensed income account of operating companies, classified according to income from railway operations.—There is considerable variation in the relative importance of the various items of the income account for companies of different sizes. Table 85 is a comparative summary of the income account of operating companies, grouped according to income from railway operations, for 1912, 1907, and 1902; and Table 86 presents percentages based upon the data given in Table 85. Table 86 shows for each item the percentage each class forms of the total for the United States for each year, and the percentage of the gross income represented by each item for the several classes of companies.

A study of the statistics shows a progressive movement of the companies from the lower to the higher class groups. The proportion of the total number formed by companies of class C decreased from 84.4 per cent in 1902 to 74.8 per cent in 1912, while classes B and A both showed an increase in their respective proportions. With respect to income account, class B maintained about the same relation to the total at each census, there being but little change in the percentages of totals represented by gross income, operating revenues and expenses, deductions from income, and net income. The decreases in percentages of totals for class C are accounted for chiefly by the increases for class A.

Table 85 CONDENSED INCOME ACCOUNT OF OPERATING COMPANIES, CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS: CLASS A, $1,000,000 AND OVER; CLASS B $250,000 BUT LESS THAN $1,000,000; CLASS C, LESS THAN $250,000.

ACCOUNT AND CLASS.	1912	1907	1902	Per cent of increase.[1]		
				1902–1912	1907–1912	1902–1907
Number of companies	975	939	799	22.0	3.8	17.5
Class A	91	76	44	106.8	19.7	72.7
Class B	155	130	81	91.4	19.2	60.5
Class C	729	733	674	8.2	−0.5	8.8
Gross income	$585,930,517	$429,744,254	$250,504,627	133.9	36.3	71.6
Class A	436,410,065	303,071,003	170,328,500	156.2	44.0	77.9
Class B	89,008,583	69,462,248	39,857,063	123.3	28.1	74.3
Class C	60,511,869	57,211,003	40,319,064	50.1	5.8	41.9
Operating revenues	567,511,704	418,187,858	247,553,999	129.2	35.7	68.9
Class A	422,793,977	297,062,346	167,743,251	152.0	42.3	77.1
Class B	86,264,601	66,807,839	39,743,376	117.1	29.1	68.1
Class C	58,453,126	54,317,673	40,067,372	45.9	7.6	35.6
Operating expenses	332,896,356	251,309,252	142,312,597	133.9	32.5	76.6
Class A	239,739,927	173,358,511	91,842,001	161.0	38.3	88.8
Class B	53,250,043	41,344,061	23,354,624	128.0	28.8	76.6
Class C	39,906,386	36,606,680	27,115,972	47.2	9.0	35.0
Net operating revenue	234,615,348	166,878,606	105,241,402	122.9	40.6	58.6
Class A	183,054,050	123,703,835	75,901,250	104.1	48.0	63.0
Class B	33,014,558	25,463,778	16,388,752	101.4	29.7	55.4
Class C	18,546,740	17,710,993	12,951,400	43.2	4.7	36.8
Miscellaneous income	18,418,813	11,556,396	2,950,628	524.2	59.4	291.7
Class A	13,616,088	6,008,657	2,585,249	......	......	......
Class B	2,743,982	2,654,409	113,687	......	......	......
Class C	2,058,743	2,893,330	251,692	......	......	......
Gross income less operating expenses	253,034,161	178,435,002	108,192,030	133.9	41.8	64.9
Class A	196,670,138	129,712,492	78,486,499	150.6	51.6	65.3
Class B	35,758,540	28,118,187	16,502,439	116.7	27.2	70.3
Class C	20,605,483	20,604,323	13,203,092	56.1	(2)	56.1
Deductions from income	191,123,408	138,094,716	77,595,053	146.3	38.4	78.0
Class A	148,640,699	102,004,702	56,819,948	161.6	45.7	79.5
Class B	25,425,531	20,911,111	10,936,393	132.5	21.6	91.2
Class C	17,057,178	15,178,903	9,838,712	72.3	12.4	54.3
Net income	61,910,753	40,340,286	30,596,977	102.3	53.5	31.8
Class A	48,029,439	27,707,790	21,666,551	121.7	73.3	27.9
Class B	10,333,009	7,207,076	5,566,046	85.6	43.4	29.5
Class C	3,548,305	5,425,420	3,364,380	5.5	−34.6	61.3
Dividends	51,650,117	26,454,732	15,882,110	225.2	95.2	66.6
Class A	40,034,088	20,819,820	12,174,336	228.8	92.2	71.0
Class B	8,309,512	3,921,313	2,342,179	254.8	111.9	67.4
Class C	3,306,517	1,713,599	1,365,595	142.1	93.0	25.5
Surplus	10,260,636	13,885,554	14,714,867	−30.3	−26.1	−5.6
Class A	7,995,351	6,887,970	9,492,215	−15.8	16.1	−27.4
Class B	2,023,497	3,285,763	3,223,867	−37.2	−38.4	1.9
Class C	241,788	3,711,821	1,998,785	−87.9	−93.5	85.7

[1] A minus sign (−) denotes decrease. [2] Less than one-tenth of 1 per cent.

Referring to Table 86: The economy in the operation of large companies as compared with small ones shows in the smaller per cent of gross income absorbed by operating expenses. It is true that deductions from income as a total absorb a larger proportion of the gross income for class A than for class B and a larger proportion for class B than for class C, but this is due chiefly to rentals paid nonoperating companies, essentially the entire amount of which is disbursed by the lessor companies as interest on funded debt or as dividends. Deductions from income are hereafter considered in detail (see p. 250).

Table 86 CONDENSED INCOME ACCOUNT OF COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS—PERCENTAGES (BASED ON TABLE 85).

ACCOUNT.	Class A—$1,000,000 and over.			Class B—$250,000 but less than $1,000,000.			Class C—Less than $250,000.		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
PER CENT OF TOTAL.									
Number of companies	9.3	8.1	5.5	15.9	13.8	10.1	74.8	78.1	84.4
Gross income	74.5	70.5	68.0	15.2	16.2	15.9	10.3	13.3	16.1
Operating revenues	74.5	71.0	67.8	15.2	16.0	16.1	10.3	13.0	16.2
Operating expenses	72.0	69.0	64.5	16.0	16.5	16.4	12.0	14.6	19.1
Net operating revenue	78.0	74.1	72.1	14.1	15.3	15.6	7.9	10.6	12.3
Miscellaneous income	73.9	52.0	87.6	14.9	23.0	3.9	11.2	25.0	8.5
Gross income less operating expenses	77.7	72.7	72.5	14.1	15.8	15.3	8.1	11.5	12.2
Deductions from income	77.8	73.9	73.2	13.3	15.1	14.1	8.9	11.0	12.7
Net income	77.6	68.7	70.8	16.7	17.9	18.2	5.7	13.4	11.0
Dividends	77.5	78.7	76.6	16.1	14.8	14.7	6.4	6.5	8.6
Surplus	77.9	49.6	64.5	19.7	23.7	21.9	2.4	26.7	13.6
PER CENT OF GROSS INCOME.									
Operating revenues	96.9	98.0	98.5	96.9	96.2	99.7	96.6	94.9	99.4
Miscellaneous income	3.1	2.0	1.5	3.1	3.8	0.3	3.4	5.1	0.6
Operating expenses	54.9	57.2	53.9	59.8	59.5	58.6	65.9	64.0	67.3
Deductions from income	34.1	33.7	33.4	28.6	30.1	27.4	28.2	26.5	24.4
Net income	11.0	9.1	12.7	11.6	10.4	14.0	5.9	9.5	8.3
Dividends	9.2	6.9	7.1	9.3	5.7	5.9	5.5	3.0	3.3
Surplus	1.8	2.3	5.6	2.3	4.7	8.1	0.4	6.5	5.0

The operating ratio—that is, the percentage which operating expenses form of operating revenues—is a gauge or index to economy in operation. The following statement gives the operating ratios for the three classes:

CLASS.	OPERATING RATIO—COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS.		
	1912	1907	1902
All companies	58.7	60.1	57.5
Class A—$1,000,000 and over	56.7	58.4	54.8
Class B—$250,000 but less than $1,000,000	61.7	61.9	58.8
Class C—Less than $250,000	68.3	67.4	67.7

The average operating ratios for classes A, B, and C, for the three years, based upon the aggregate operating revenue and the aggregate operating expenses for the three years, are: For class A, 56.9 per cent; class B, 61.2 per cent; and class C, 67.8 per cent.

Condensed income account of operating companies without and with commercial lighting.—The generation and sale of electricity by railway companies for purposes other than the operation of the railways necessarily have some effect upon the proportions that the different items of income and expense represent of the respective totals. Table 87 is a comparative summary, for 1912, 1907, and 1902, of the income accounts of operating companies that do not conduct light and power departments in connection with the railways, designated as companies "without commercial lighting," or "class X;" companies that generate and sell electricity for light, power, and other purposes, designated as companies "with commercial lighting," or "class Y;" and the group of miscellaneous companies, chiefly those operated for a part of the year only and including most of the small horse railroads, designated as "miscellaneous," or "class Z." Class Y does not include railway companies with light and power departments which made separate reports, with segregation of capitalization and all financial data, for the railway and light and power departments.

Table 87 CONDENSED INCOME ACCOUNT OF OPERATING COMPANIES WITHOUT AND WITH COMMERCIAL LIGHTING: CLASS X, WITHOUT COMMERCIAL LIGHTING; CLASS Y, WITH COMMERCIAL LIGHTING; CLASS Z, MISCELLANEOUS.

ACCOUNT AND CLASS.	1912	1907	1902	Per cent of increase.[1]		
				1902-1912	1907-1912	1902-1907
Number of companies	975	[2] 939	[3] 799	22.0	3.8	17.5
Class X	760	709	630	20.7	7.2	12.5
Class Y	[4] 168	[5] 175	112	50.0	−4.0	56.3
Class Z	47	55	57	....	....	....
Gross income	$585,930,517	$429,744,254	$250,504,627	133.9	36.3	71.6
Class X	476,872,025	356,704,386	225,611,197	111.4	33.7	58.1
Class Y	108,004,359	71,768,709	22,418,065	381.8	50.5	220.1
Class Z	1,054,133	1,271,159	2,475,365	....	....	....
Operating revenues	567,511,704	418,187,858	247,553,999	129.2	35.7	68.9
Class X	461,908,807	347,955,013	222,989,978	107.2	32.7	56.0
Class Y	104,575,497	68,986,416	22,088,656	373.4	51.6	212.3
Class Z	1,027,400	1,246,429	2,475,365	....	....	....
Operating expenses	332,896,356	251,309,252	142,312,597	133.9	32.5	76.6
Class X	273,622,168	208,847,845	128,038,482	113.7	31.0	63.1
Class Y	58,520,068	41,566,582	12,834,941	355.9	40.8	223.9
Class Z	754,120	894,825	1,439,174	....	....	....
Net operating revenue	234,615,348	166,878,606	105,241,402	122.9	40.6	58.6
Class X	188,286,639	139,107,168	94,951,496	98.3	35.4	46.5
Class Y	46,055,429	27,419,834	9,253,715	397.7	68.0	196.3
Class Z	273,280	351,604	1,036,191	....	....	....
Miscellaneous income	18,418,813	11,556,396	2,950,628	524.2	59.4	291.7
Class X	14,963,218	8,749,373	2,621,219	470.8	71.0	233.8
Class Y	3,428,862	2,782,293	329,409	940.9	23.2	744.6
Class Z	26,733	24,730	....	....	....	....
Gross income less operating expenses	253,034,161	178,435,002	108,192,030	133.9	41.8	64.9
Class X	203,249,857	147,856,541	97,572,715	108.3	37.5	51.5
Class Y	49,484,291	30,202,127	9,583,124	416.4	63.8	215.2
Class Z	300,013	376,334	1,036,191	....	....	....
Deductions from income	191,123,408	138,094,716	77,595,053	146.3	38.4	78.0
Class X	157,930,180	117,688,115	71,027,194	122.4	34.2	65.7
Class Y	32,938,361	19,944,704	6,007,847	448.3	65.1	232.0
Class Z	254,867	461,897	560,012	....	....	....
Taxes	35,027,965	19,755,602	13,078,899	167.8	77.3	51.0
Class X	29,507,142	16,755,648	12,294,585	140.0	76.1	36.3
Class Y	5,477,369	2,976,684	733,575	646.6	84.0	305.8
Class Z	43,454	23,270	50,739	....	....	....
Interest	98,025,338	63,740,744	38,085,911	157.4	53.8	67.4
Class X	78,108,915	50,534,496	32,728,041	138.7	54.6	54.4
Class Y	19,708,006	12,782,361	4,849,800	306.3	54.2	163.6
Class Z	208,417	423,887	508,070	....	....	....
Rent of leased lines and terminals	44,784,521	48,022,596	25,518,225	75.5	−6.7	88.2
Class X	39,246,647	45,328,842	25,470,229	54.1	−13.4	78.0
Class Y	5,535,054	2,693,754	47,413	....	....	....
Class Z	2,820	....	583	....	....	....
Miscellaneous	13,285,584	6,575,774	912,018	....	....	....
Class X	11,067,476	5,069,129	534,339	....	....	....
Class Y	2,217,932	1,491,905	377,059	....	....	....
Class Z	176	14,740	620	....	....	....
Net income	61,910,753	40,340,286	30,596,977	102.3	53.5	31.8
Class X	45,319,677	30,168,426	26,545,521	70.7	50.2	13.6
Class Y	16,545,930	10,257,423	3,575,277	362.8	61.3	186.9
Class Z	45,146	−85,563	476,179	....	....	....
Dividends	51,650,117	26,454,732	15,882,110	225.2	95.2	66.6
Class X	39,439,692	22,476,056	15,022,519	162.5	75.5	49.6
Class Y	12,199,579	3,971,059	813,091	....	....	....
Class Z	10,846	7,617	46,500	....	....	....
Surplus	10,260,636	13,885,554	14,714,867	−30.3	−26.1	−5.6
Class X	5,879,985	7,692,370	11,523,002	−48.9	−23.6	−33.2
Class Y	4,346,351	6,286,364	2,762,186	57.4	−30.9	127.6
Class Z	34,300	−93,180	429,679	....	....	....

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[1] A minus sign (−) denotes decrease.
[2] Exclusive of 6 companies which failed to furnish this information.
[3] Exclusive of 18 companies which failed to furnish this information.
[4] Exclusive of 1 part-time company.
[5] Exclusive of 2 part-time companies.

There were 44 railway companies with light and power departments that made separate reports for such departments in 1912, and these are included in the report on Central Electric Light and Power Stations. Table 88 gives percentages based upon Table 87. It shows the percentages which each item for classes X and Y forms of the total for the United States at each census, together with the percentage of gross income represented by each item for these classes. Percentages for class Z are omitted from these tables, as they are so small as to be of no statistical value.

Table 88 CONDENSED INCOME ACCOUNT OF COMPANIES WITHOUT AND WITH COMMERCIAL LIGHTING—PER CENT OF TOTAL.[1]

ACCOUNT.	Class X. Companies without commercial lighting.			Class Y. Companies with commercial lighting.		
	1912	1907	1902	1912	1907	1902
PER CENT OF TOTAL.						
Number of companies	77.9	75.5	78.8	17.2	18.6	14.0
Gross income	81.4	83.0	90.1	18.4	16.7	8.9
Operating revenues	81.4	83.2	90.1	18.4	16.5	8.9
Operating expenses	82.2	83.1	90.1	17.6	16.5	9.0
Net operating revenue	80.3	83.4	90.2	19.6	16.4	8.8
Miscellaneous income	81.2	75.7	88.8	18.6	24.1	11.2
Gross income less operating expenses	80.3	82.9	90.2	19.6	16.9	8.9
Deductions from income	82.6	85.2	91.5	17.2	14.4	7.7
Taxes	84.2	84.8	94.0	15.6	15.1	5.6
Interest	79.7	79.3	85.9	20.1	20.0	12.7
Rent of leased lines and terminals	87.6	94.4	99.8	12.4	5.6	0.2
Miscellaneous	83.3	77.1	58.6	16.7	22.7	41.3
Net income	73.2	74.8	86.8	26.7	25.4	11.7
Dividends	76.4	85.0	94.6	23.6	15.0	5.1
Surplus	57.3	55.4	78.3	42.4	45.3	18.8
PER CENT OF GROSS INCOME.						
Operating revenues	96.9	97.5	98.8	96.8	96.1	98.5
Miscellaneous income	3.1	2.5	1.2	3.2	3.9	1.5
Operating expenses	57.4	58.5	56.8	54.2	57.9	57.3
Deductions from income	33.1	33.0	31.5	30.5	27.8	26.8
Taxes	6.2	4.7	5.4	5.1	4.1	3.3
Interest	16.4	14.2	14.5	18.2	17.8	21.6
Rent of leased lines and terminals	8.2	12.7	11.3	5.1	3.8	0.2
Miscellaneous	2.3	1.4	0.2	2.1	2.1	1.7
Net income	9.5	8.5	11.8	15.3	14.3	15.9
Dividends	8.3	6.3	6.7	11.3	5.5	3.6
Surplus	1.2	2.2	5.1	4.0	8.8	12.3

[1] Class Z—Miscellaneous: 4.8 per cent of companies in 1912, 5.9 per cent in 1907, and 7.1 per cent in 1902; 1 per cent or less of income accounts.

Not all of the income from sale of electric current by railway companies is included under class Y. There were 381 companies in 1912 which reported income from the sale of current. Of these, 169 had light and power departments (168 in class Y, and 1, a part-time company, in class Z). The other 212 companies reported a total income of $5,515,475 from the sale of current, chiefly current supplied to affiliated or connecting railways, or sold incidentally. As this amount was not so great as to affect perceptibly the operating railway accounts, these companies were included in class X. In 1907 there were 153 such companies, with $3,516,747 income from the sale of current, included in class X.

Table 89 shows the number of companies selling electric current in 1912 and how reported, by geographic divisions.

Table 89 NUMBER OF ELECTRIC RAILWAY COMPANIES WITH INCOME FROM SALE OF ELECTRIC CURRENT: 1912.

DIVISION.[1]	Companies with light and power departments.			Companies reporting sale of electric current.		
	Total.	Data for light and power departments included in report for Street and Electric Railways.	Separate reports for light and power departments included in report for Central Electric Light and Power Stations.	Total.	Companies doing commercial lighting.	Companies not doing commercial lighting.
United States	213	169	44	381	169	212
New England	12	6	6	33	6	27
Middle Atlantic	20	12	8	78	12	66
East North Central	59	49	10	107	49	58
West North Central	26	22	4	39	22	17
South Atlantic	38	35	3	53	35	18
East South Central	21	14	7	19	14	5
West South Central	17	14	3	23	14	9
Mountain	9	7	2	11	7	4
Pacific	11	10	1	18	10	8

[1] See page 25 for states composing the several divisions.

Income from sale of electric current was a more important factor in 1912 than at the earlier censuses, and formed 6.4 per cent of the operating revenues in 1912, as compared with 4.8 per cent in 1907 and 3.1 per cent in 1902. The companies of class Y contributed 18.4 per cent of the operating revenues for all companies in 1912, as compared with 16.5 per cent in 1907 and 8.9 per cent in 1902. The percentages of increase for all items shown in Table 87 range, as a rule, much higher for this class of companies than they do for companies of class X. For the most part the railways engaged in commercial light and power business are located in the smaller cities or towns. The per cent of income absorbed by rentals of leased lines and terminals ranges much lower than for companies of class X, although considerably higher in 1912 than in 1907, and in 1907 than in 1902, and the proportions for total deductions from income are considerably lower for class Y than for class X, the former showing a much higher ratio for net income, namely, 15.3 per cent, as compared with 9.5 per cent for class X, in 1912, and 15.9 per cent, as compared with 11.8 per cent for class X, in 1902.

The operating ratios for these classes of companies, for 1912, 1907, and 1902, were as follows:

CLASS.	COMPANIES WITHOUT AND WITH COMMERCIAL LIGHTING—OPERATING RATIO (PER CENT).		
	1912	1907	1902
All companies	58.7	60.1	57.5
Class X—Without commercial lighting	59.2	60.0	57.4
Class Y—With commercial lighting	56.0	60.3	58.1
Class Z—Miscellaneous	73.4	71.8	58.1

Condensed income account of companies classified as "Elevated and subway" and "Surface."—The operating conditions of the elevated and subway railways and the surface roads are so different as to give value to an analysis of the statistics for these groups. Table 90 is a comparative summary, for 1912 and 1907, of the income accounts of operating companies, classified as "Elevated and subway" and "Surface," and Tables 91 and 92 give percentages based upon Table 90, the former showing the percentage of the item total represented by each group and the latter the percentage of the gross income represented by each item.

Table 90 CONDENSED INCOME ACCOUNT OF OPERATING COMPANIES, CLASSIFIED AS "ELEVATED AND SUBWAY" AND "SURFACE."

ACCOUNT AND CLASS.	1912	1907	Per cent of increase.[1]
Number of companies	975	939	3.8
Elevated and subway	7	6	16.7
Surface	968	933	3.8
Gross income	$585,930,517	$429,744,254	36.3
Elevated and subway	55,246,361	34,257,979	61.3
Surface	530,684,156	395,486,275	34.2
Operating revenues	567,511,704	418,187,858	35.7
Elevated and subway	52,238,727	33,874,054	54.2
Surface	515,272,977	384,313,804	34.1
Operating expenses	332,896,356	251,309,252	32.5
Elevated and subway	23,612,867	15,129,025	56.1
Surface	309,283,489	236,180,227	31.0
Net operating revenue	234,615,348	166,878,606	40.6
Elevated and subway	28,625,860	18,745,029	52.7
Surface	205,989,488	148,133,577	39.1
Miscellaneous income	18,418,813	11,556,396	59.4
Elevated and subway	3,007,634	383,925	683.4
Surface	15,411,179	11,172,471	37.9
Gross income less operating expenses	253,034,161	178,435,002	41.8
Elevated and subway	31,633,494	19,128,954	65.4
Surface	221,400,667	159,306,048	39.0
Deductions from income	191,123,408	138,094,716	38.4
Elevated and subway	22,732,065	13,459,216	68.9
Surface	168,391,343	124,635,500	35.1
Taxes	35,027,965	19,755,602	77.3
Elevated and subway	3,500,657	1,986,249	76.2
Surface	31,527,308	17,769,353	77.4
Interest	98,025,338	63,740,744	53.8
Elevated and subway	9,654,473	3,700,602	160.9
Surface	88,370,865	60,040,142	47.2
Rent of leased lines and terminals	44,784,521	48,022,596	−6.7
Elevated and subway	8,795,655	5,966,120	47.4
Surface	35,988,866	42,056,476	−14.4
Miscellaneous	13,285,584	6,575,774	102.0
Elevated and subway	781,280	1,806,245	−56.7
Surface	12,504,304	4,769,529	162.2
Net income	61,910,753	40,340,286	53.5
Elevated and subway	8,901,429	5,669,738	57.0
Surface	53,009,324	34,670,548	52.9
Dividends	51,650,117	26,454,732	95.2
Elevated and subway	8,529,636	4,008,880	112.8
Surface	43,120,481	22,445,852	92.1
Surplus	10,260,636	13,885,554	−26.1
Elevated and subway	371,793	1,660,858	−77.6
Surface	9,888,843	12,224,696	−19.1
Ratio of operating expenses to operating revenues (per cent):			
All companies	58.7	60.1	....
Elevated and subway	45.2	44.7	....
Surface	60.0	61.5	....

[1] A minus sign (—) denotes decrease.

Table 91 CONDENSED INCOME ACCOUNT OF COMPANIES CLASSIFIED AS "ELEVATED AND SUBWAY" AND "SURFACE"—PER CENT OF TOTAL.

ACCOUNT.	Elevated and subway.		Surface.	
	1912	1907	1912	1907
Number of companies	0.7	0.6	99.3	99.4
Gross income	9.4	8.0	90.6	92.0
Operating revenues	9.2	8.1	90.8	91.9
Operating expenses	7.1	6.0	92.9	94.0
Net operating revenue	12.2	11.2	87.8	88.8
Miscellaneous income	16.3	3.3	83.7	96.7
Gross income less operating expenses	12.5	10.7	87.5	89.3
Deductions from income	11.9	9.7	88.1	90.3
Taxes	10.0	10.1	90.0	89.9
Interest	9.8	5.8	90.2	94.2
Rent of leased lines and terminals	19.6	12.4	80.4	87.6
Miscellaneous	5.9	27.5	94.1	72.5
Net income	14.4	14.1	85.6	85.9
Dividends	16.5	15.2	83.5	84.8
Surplus	3.6	12.0	96.4	88.0

Table 92 CONDENSED INCOME ACCOUNT OF COMPANIES CLASSIFIED AS "ELEVATED AND SUBWAY" AND "SURFACE"—PER CENT OF GROSS INCOME.

ACCOUNT.	Total—All companies.		Elevated and subway.		Surface.	
	1912	1907	1912	1907	1912	1907
Gross income	100.0	100.0	100.0	100.0	100.0	100.0
Operating revenues	96.9	97.3	94.6	98.9	97.1	97.2
Miscellaneous income	3.1	2.7	5.4	1.1	2.9	2.8
Operating expenses	56.8	58.5	42.7	44.2	58.3	59.7
Deductions from income	32.6	32.1	41.1	39.3	31.7	31.5
Taxes	6.0	4.6	6.3	5.8	5.9	4.5
Interest	16.7	14.8	17.5	10.8	16.7	15.2
Rent of leased lines and terminals	7.6	11.2	15.9	17.4	6.8	10.6
Miscellaneous	2.3	1.5	1.4	5.3	2.4	1.2
Net income	10.6	9.4	16.1	16.5	10.0	8.8
Dividends	8.8	6.2	15.4	11.7	8.1	5.7
Surplus	1.8	3.2	0.7	4.8	1.9	3.1

The elevated and subway group shows a low ratio of operating expenses to gross income and a reduction in the ratio from 1907 to 1912, namely, from 44.2 per cent in 1907 to 42.7 per cent in 1912. The proportion absorbed by deductions from income for the elevated and subway group is largely in excess of that for the surface roads, primarily by reason of the large proportion of income required for rentals.

OPERATING REVENUES AND MISCELLANEOUS INCOME.

Operating revenues.—Table 161 (p. 308) gives the operating revenues, by geographic divisions and states, for 1912, 1907, and 1902, and the sources from which derived. Operating revenues include the income from passenger, parlor, chair, and special cars, and from freight, mail, baggage, express, and milk; other transportation revenue; receipts from sale of electric current; and other nontransportation revenue. Passenger revenue includes cash-fare collections, receipts from sale of tickets, and the cash equivalent of mileage tickets honored for transportation. Parlor, chair, and special car revenue includes fares collected for seats in parlor, observation, chair, and other special passenger cars, and revenue from cars chartered for special passenger service. Freight revenue is what the name implies. Mail revenue includes amounts received for the transportation of mails and for the use of railway post-office cars and special facilities, and bonuses for special mail transportation. Baggage revenue includes amounts received for the transportation of baggage in excess of free allowances and for the transportation of packages, other articles, dogs, etc., as baggage. The term "express" covers matter handled at a higher rate than freight on account of quicker service or of collection and delivery, and express revenue includes amounts received for transportation or for facilities on cars and at stations incident to the transportation of express matter, not including the separate rent of offices at stations. On some lines the transportation of milk is an important feature. "Other transportation revenue" includes amounts received for switching service and for all transportation service not otherwise provided for. Income from the sale of electric current, either to other public-service corporations or to the general public, is, next to passenger revenue, the largest item of operating income, and it constitutes the greater part of the nontransportation operating revenues. Included under "Other nontransportation revenue" are amounts received for station and car privileges, advertising at stations and on cars, parcel-room service, the storage of freight and baggage, car demurrage, telegraph and telephone service in cases where the expense can not be separated from the expense of conducting the railway service, rent of tracks and terminals, rent of cars, rent of electrical equipment of cars and other equipment, rent of buildings or other property used in connection with railway operations, such as depot and station grounds and buildings, offices and rooms rented at stations, etc., and receipts from parks and pleasure resorts. The standard form of accounting provides that only the net income or net expense of parks or amusement resorts operated primarily for the purpose of attracting traffic shall be carried in the railway accounts. In some cases it is possible that the total expense and the gross income were reported, which would not affect the data for net income, although tending to inflate the income and expense accounts.

The following statement illustrates the differences in the relative importance of the several sources of revenue for street and electric railways and steam railroads in 1912 and 1907:

CLASS OF SERVICE.	PER CENT DISTRIBUTION OF OPERATING REVENUES, BY SOURCE, FOR STREET AND ELECTRIC RAILWAYS AND STEAM RAILROADS.			
	Street and electric railways.		Steam railroads.	
	1912	1907	1912	1907
Operating revenues	100.0	100.0	100.0	100.0
Passenger service	88.8	91.5	23.2	21.8
Freight service	1.8	1.3	69.3	70.4
Mail service	0.1	0.2	1.8	1.9
Express service	0.6	0.4	2.6	2.2
All other	8.7	6.7	3.2	3.6

The income from passenger service represents approximately nine-tenths of the operating revenues of the street and electric railways, while freight service yields about seven-tenths of the operating income of the steam roads; but for each the percentage is slightly lower for 1912 than for 1907.

Table 93, based on Table 161 (p. 308), gives the percentages of increase for the census periods 1902–1912, 1907–1912, and 1902–1907, by geographic divisions, for operating revenues and the component accounts, grouped as "Passenger service," which includes "Passenger" and "Parlor, chair, and special car;" "Freight, mail, baggage, and express" (including milk); "Sale of electric current;" and "All other revenue," including "Other transportation revenue" for 1912.

Table 93 OPERATING REVENUES, BY SOURCE AND BY GEOGRAPHIC DIVISIONS—PER CENT OF INCREASE[1] (BASED ON TABLE 161).

DIVISION.	Operating revenues.			Passenger service.[2]			Freight, mail, baggage, and express.[3]			Sale of electric current.			All other revenue.		
	1902–1912	1907–1912	1902–1907	1902–1912	1907–1912	1902–1907	1902–1912	1907–1912	1902–1907	1902–1912	1907–1912	1902–1907	1902–1912	1907–1912	1902–1907
United States	129.2	35.7	68.9	115.1	31.6	63.5	678.8	95.9	297.4	373.8	81.7	160.7	230.8	63.0	102.9
New England	69.9	21.8	39.5	66.4	21.7	36.8	376.5	105.2	132.2	87.9	−11.5	112.3	89.7	24.5	52.4
Middle Atlantic	96.0	30.0	50.8	90.5	28.5	48.2	393.7	53.6	221.6	440.5	67.6	222.5	199.8	62.3	84.7
East North Central	146.1	36.4	80.4	130.6	32.4	74.2	757.3	92.5	345.3	287.0	80.9	113.9	273.6	34.3	178.3
West North Central	144.9	33.4	83.6	133.7	29.4	80.7	966.1	176.9	285.1	287.4	70.1	127.9	385.5	115.6	125.2
South Atlantic	163.2	38.3	90.3	141.8	34.6	79.6	470.6	122.0	157.1	304.1	49.0	171.1	115.2	47.5	45.9
East South Central	160.6	27.5	104.5	137.9	23.6	92.4	456.5	72.1	223.4	330.8	50.2	186.8	436.0	−11.9	508.4
West South Central	252.6	52.8	130.8	217.6	49.7	112.1	1,138.0	165.2	366.8	1,685.0	68.8	957.6	419.7	137.1	119.3
Mountain	235.7	54.7	117.0	164.6	43.1	84.8	239.5	37.8	146.5	1,578.3	95.6	758.2	409.5	306.1	25.5
Pacific	302.0	74.0	131.1	250.7	53.9	127.9	1,957.4	122.7	823.9	615.1	340.7	62.3	679.4	266.9	112.4

[1] A minus sign (—) denotes decrease.

[2] Including "Parlor, chair, and special car."

[3] Including "Milk."

The proportionate increase in income from freight, mail, baggage, and express business greatly exceeds that from passenger service for each division and each five-year period, except in the case of the Mountain division for the period 1907–1912; and the same is true of income from sale of electric current, except in the case of the New England division for the period 1907–1912. The growth in freight, mail, baggage, and express business was specially large in the West Central divisions, both North and South, and on the Pacific coast.

Table 94, also based upon Table 161 (p. 308), gives the per cent distribution of each class of operating revenue, by geographic divisions, and the per cent distribution of the operating revenues for each geographic division, according to source or class, for 1912 and 1907.

The Middle Atlantic division led in total operating revenue and passenger revenue for both 1912 and 1907 and in mail revenue for 1907, while the East North Central division led in revenue from parlor, chair, and special cars, from freight, and from baggage, express and milk business for both years, and in mail revenue and income from sale of electric current for 1912. The South Atlantic division reported the largest amount of income from sale of electric current in 1907. In every division, with the exception of the Middle Atlantic, the proportion of the operating revenue derived from passengers is less in 1912 than in 1907, and, with the exception of the New England and Middle Atlantic divisions, the proportion represented by income from sale of electric current is greater. The freight percentages, although small, show, as a rule, a proportionate increase. The only divisions where these percentages are less for 1912 than for 1907 are the East South Central and Mountain.

STREET AND ELECTRIC RAILWAYS—PER CENT DISTRIBUTION OF OPERATING REVENUES, BY GEOGRAPHIC DIVISIONS: 1912 AND 1907 (BASED ON TABLE 157).

Table 94

DIVISION.	Census.	Operating revenues, total.	Passenger.	Parlor, chair, and special car.	Freight.	Mail.	Baggage, express, and milk.	Other transportation revenue.	Sale of electric current.	Other nontransportation revenue.
PER CENT OF TOTAL.										
United States	1912	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	1907	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
New England	1912	10.0	10.5	18.7	8.1	14.5	11.0	4.2	3.8	9.2
	1907	11.1	11.3	21.2	5.5	16.0	16.7	....	7.8	11.1
Middle Atlantic	1912	33.8	35.9	24.4	13.8	23.2	19.2	24.7	9.3	43.0
	1907	35.2	36.8	24.5	14.9	28.7	33.3	....	10.0	40.4
East North Central	1912	23.8	23.5	31.3	34.4	23.9	47.7	38.0	22.8	21.6
	1907	23.7	23.4	25.5	40.7	21.9	34.9	....	22.9	29.2
West North Central	1912	7.9	8.1	3.9	7.2	17.5	3.6	6.0	6.1	6.0
	1907	8.0	8.3	4.4	4.4	14.2	2.2	....	6.5	4.6
South Atlantic	1912	7.0	6.2	5.9	5.1	8.3	5.1	3.1	19.4	5.1
	1907	6.8	6.0	3.6	4.0	9.3	4.9	....	23.7	5.4
East South Central	1912	3.0	2.8	1.1	1.7	2.2	2.8	1.5	7.6	1.1
	1907	3.2	2.9	2.8	2.9	2.1	0.1	....	9.2	2.1
West South Central	1912	3.0	2.9	2.7	0.4	0.8	0.7	2.0	5.1	2.2
	1907	2.7	2.6	2.0	0.3	0.9	0.5	....	5.5	1.5
Mountain	1912	2.0	1.6	2.6	1.2	0.7	1.4	1.1	7.2	1.7
	1907	1.7	1.5	3.2	2.5	0.4	0.1	....	6.7	0.6
Pacific	1912	9.6	8.5	9.4	28.0	8.8	8.6	19.5	18.7	10.0
	1907	7.5	7.3	12.9	24.8	6.5	7.3	....	7.7	5.1
PER CENT OF OPERATING REVENUES.										
United States	1912	100.0	88.6	0.2	1.8	0.1	0.6	0.3	6.4	1.9
	1907	100.0	91.4	0.2	1.3	0.1	0.4	....	4.8	1.9
New England	1912	100.0	92.9	0.3	1.5	0.2	0.7	0.1	2.5	1.8
	1907	100.0	93.0	0.3	0.6	0.2	0.6	....	3.4	1.9
Middle Atlantic	1912	100.0	94.2	0.1	0.7	0.1	0.4	0.2	1.8	2.4
	1907	100.0	95.4	0.1	0.6	0.2	0.4	....	1.4	1.9
East North Central	1912	100.0	87.3	0.2	2.6	0.1	1.3	0.5	6.2	1.7
	1907	100.0	90.0	0.2	2.2	0.1	0.5	....	4.6	2.3
West North Central	1912	100.0	91.0	0.1	1.6	0.3	0.3	0.3	5.0	1.5
	1907	100.0	93.9	0.1	0.7	0.3	0.1	....	3.9	1.1
South Atlantic	1912	100.0	78.4	0.2	1.3	0.2	0.5	0.1	18.0	1.4
	1907	100.0	80.6	0.1	0.7	0.2	0.3	....	16.7	1.5
East South Central	1912	100.0	81.2	0.1	1.0	0.1	0.6	0.2	16.2	0.7
	1907	100.0	83.6	0.1	1.1	0.1	(1)	....	13.7	1.3
West South Central	1912	100.0	86.9	0.2	0.3	(1)	0.1	0.2	10.9	1.4
	1907	100.0	88.7	0.1	0.1	0.1	0.1	....	9.9	1.0
Mountain	1912	100.0	72.6	0.2	1.1	(1)	0.5	0.2	23.7	1.6
	1907	100.0	78.4	0.3	1.8	(1)	(1)	....	18.7	0.7
Pacific	1912	100.0	78.7	0.2	5.2	0.1	0.6	0.7	12.5	2.0
	1907	100.0	88.9	0.3	4.1	0.1	0.4	....	4.9	1.3

(1) Less than one-tenth of 1 per cent.

Operating revenues of companies classified according to income from railway operations.—The classification of railways according to size is based upon income from railway operations; hence income from the sale of current (which is an operating income), other nontransportation revenues, and items of income that make up the total of "Miscellaneous income" not from operations, do not affect the classification, however large they may be. The development of interurban lines has brought in a large amount of freight and express business. The relative importance of the passenger service and other classes of service varies somewhat with the size and character of the companies and the locality served. Table 95 gives the comparative statistics for operating revenues, by source, for companies classified according to income from railway operations.

Table 95

OPERATING REVENUES, BY SOURCE, OF COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS: CLASS A, $1,000,000 AND OVER; CLASS B, $250,000 BUT LESS THAN $1,000,000; CLASS C, LESS THAN $250,000.

ACCOUNT.	1912	1907	1902	Per cent of increase.[1]		
				1902–1912	1907–1912	1902–1907
Number of companies	975	939	799	22.0	3.8	17.5
Class A	91	76	44	106.8	19.7	72.7
Class B	155	130	81	91.4	19.2	60.5
Class C	729	733	674	8.2	0.5	8.8
Operating revenues	$567,511,704	$418,187,858	$247,553,999	129.2	35.7	68.9
Class A	422,793,977	297,062,346	167,743,251	152.0	42.3	77.1
Class B	86,264,601	66,807,839	39,743,376	117.1	29.1	68.1
Class C	58,453,126	54,317,673	40,067,372	45.9	7.6	35.6
Passenger	502,651,637	382,132,494	233,821,548	115.0	31.5	63.4
Class A	387,824,233	280,387,112	162,529,682	138.6	38.3	72.5
Class B	70,090,673	58,176,517	36,766,021	90.6	20.5	58.2
Class C	44,736,731	43,568,865	34,525,845	29.6	2.7	26.2
Parlor, chair, and special car[2]	1,036,520	705,261	303,608	241.4	47.0	132.3
Class A	698,801	437,082	172,269	305.6	59.9	153.7
Class B	216,575	155,292	64,030	238.2	39.5	142.5
Class C	121,144	112,887	67,309	80.0	7.3	67.7
Freight	10,165,616	5,231,215	1,038,097	879.3	94.3	403.9
Class A	4,909,404	1,571,763	164,712	2,880.6	212.4	854.2
Class B	2,933,011	1,958,313	271,062	982.0	49.8	622.5
Class C	2,323,201	1,701,139	602,323	285.7	36.6	182.4
Mail	723,640	646,575	432,080	67.5	11.9	49.6
Class A	504,260	448,462	287,407	75.5	12.4	56.0
Class B	106,163	81,931	60,019	76.9	29.6	36.5
Class C	113,217	116,182	84,654	33.7	−2.6	37.2
Baggage, express, and milk[3]	3,687,947	1,560,802	401,672	818.1	136.3	288.6
Class A	1,916,102	873,980	144,465	1,226.3	119.2	505.0
Class B	1,158,131	396,926	118,552	876.9	191.8	234.8
Class C	613,714	289,896	138,655	342.6	111.7	109.1
Other transportation revenue[4]	1,919,413	....	....	......	......	......
Class A	1,228,410	....	....	......	......	......
Class B	404,405	....	....	......	......	......
Class C	286,598	....	....	......	......	......
Sale of electric current	36,500,030	20,093,302	7,703,574	373.8	81.7	160.8
Class A	17,738,966	7,538,308	2,145,348	726.8	135.3	251.4
Class B	9,728,987	4,952,620	1,721,828	465.0	96.4	187.6
Class C	9,032,077	7,602,374	3,836,398	135.4	18.8	98.2
Other nontransportation operating revenue[5]	10,826,901	7,818,209	3,853,420	181.0	38.5	102.9
Class A	7,973,801	5,805,639	2,299,368	246.8	37.3	152.5
Class B	1,626,656	1,086,240	741,864	119.3	49.8	46.4
Class C	1,226,444	926,330	812,188	51.0	32.4	14.1

[1] A minus sign (—) denotes decrease.
[2] Reported as "Chartered cars" in 1907 and 1902.
[3] Reported as "Express" in 1907 and 1902.
[4] Included in revenues from "Miscellaneous sources" in 1907 and 1902.
[5] Reported as revenues from "Miscellaneous sources" in 1907 and 1902.

The exclusion of income from sale of current, in classifying the companies according to size, obviously results in the assignment of some companies to classes lower than those to which they would have been assigned on the basis of gross income.

The average operating revenues per company for all companies of each class are as follows:

CLASS.	AVERAGE OPERATING REVENUES PER COMPANY.		
	1912	1907	1902
All companies	$582,063	$445,354	$309,830
Class A	4,646,088	3,908,715	3,812,347
Class B	556,546	513,906	490,659
Class C	80,183	74,103	59,447

Table 96 gives the percentage data, derived from Table 95, for each class and for each year.

Table 96

PER CENT DISTRIBUTION OF OPERATING REVENUES, BY SOURCE, OF COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS (BASED ON TABLE 95).

ACCOUNT.	Class A. $1,000,000 and over.			Class B. $250,000 but less than $1,000,000.			Class C. Less than $250,000.		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
PER CENT OF TOTAL.									
Number of companies	9.3	8.1	5.5	15.9	13.8	25.2	74.8	78.1	69.3
Operating revenues	74.5	71.0	67.8	15.2	16.0	16.1	10.3	13.0	16.2
Passenger	77.2	73.4	69.5	13.9	15.2	15.7	8.9	11.4	14.8
Parlor, chair, and special car	67.4	62.0	56.7	20.9	22.0	21.1	11.7	16.0	22.2
Freight	48.3	30.0	15.9	28.9	37.4	26.1	22.9	32.5	58.0
Mail	69.7	69.4	66.5	14.7	12.7	13.9	15.6	18.0	19.6
Baggage, express, and milk	52.0	56.0	36.0	31.4	25.4	29.5	16.6	18.6	34.5
Other transportation revenue	64.0	.....	.....	24.1	.....	.....	19.9	.....	.....
Sale of electric current	48.6	37.5	27.8	26.7	24.6	22.3	24.7	37.8	49.8
Other nontransportation revenue	73.6	74.3	59.7	15.0	13.9	19.3	11.3	11.8	21.1
PER CENT OF OPERATING REVENUES.									
Operating revenue	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Passenger	91.7	94.4	96.9	81.2	87.1	92.5	76.5	80.2	86.2
Parlor, chair, and special car	0.2	0.1	0.1	0.3	0.2	0.2	0.2	0.2	0.2
Freight	1.2	0.5	0.1	3.4	2.9	0.7	4.0	3.1	1.5
Mail	0.1	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2
Baggage, express, and milk	0.5	0.3	0.1	1.3	0.6	0.3	1.1	0.5	0.3
Other transportation revenue	0.3	.....	.....	0.5	.....	.....	0.5	.....	.....
Sale of electric current	4.2	2.5	1.3	11.3	7.4	4.3	15.5	14.0	9.6
Other nontransportation revenue	1.9	2.0	1.4	1.9	1.6	1.9	2.1	1.7	2.0

The large companies, constituting class A, account for over three-fifths of the total receipts from passengers, from parlor, chair, and special cars, from mail service, and from miscellaneous nontransportation revenues, in 1912 and 1907; and the only specified classes of revenue for which these large companies did not report more than half of the respective totals were freight service and the sale of electric current.

Although passenger traffic is the chief source of revenue for all companies in class C, it constituted but 76.5 per cent of the operating revenues in 1912, as compared with 86.2 per cent in 1902. Passenger traffic furnished a considerably greater proportion for each of the other classes, but these percentages show a decrease for each class from census to census. The counterbalancing increases for all classes are found in receipts from freight, baggage, express, and milk, and from sale of electric current. Freight service and sale of current are relatively of more importance among companies of classes C and B than among those of class A.

Operating revenues of companies without and with commercial lighting.—The operating revenues of companies without commercial lighting and with commercial lighting, respectively, and of the group of miscellaneous companies are distributed among the specified sources in Table 97.

Table 97 OPERATING REVENUES, BY SOURCE, OF COMPANIES WITHOUT AND WITH COMMERCIAL LIGHTING: CLASS X, WITHOUT COMMERCIAL LIGHTING; CLASS Y, WITH COMMERCIAL LIGHTING; CLASS Z, MISCELLANEOUS.

ACCOUNT AND CLASS.	191	1907	1902	Per cent of increase.[1]		
				1902–1912	1907–1912	1902–1907
Number of companies	975	939	799	22.0	3.8	17.5
Class X	760	709	630	20.6	7.2	12.5
Class Y	168	175	112	50.0	−4.0	56.3
Class Z	47	55	57	......	......	......
Operating revenues	$567,511,704	$418,187,858	$247,553,999	129.2	35.7	68.9
Class X	461,908,807	347,955,013	222,989,978	107.1	32.7	56.0
Class Y	104,575,497	68,986,416	22,088,656	373.4	51.6	212.3
Class Z	1,027,400	1,246,429	2,475,365	......	......	......
Passenger	502,651,637	382,132,494	233,821,548	142.8	48.5	63.4
Class X	434,530,907	331,504,175	216,392,393	100.8	31.1	53.2
Class Y	67,301,669	49,500,161	15,084,584	346.2	36.0	228.2
Class Z	819,061	1,128,158	2,344,571	......	......	......
Parlor, chair, and special car[2]	1,036,520	705,261	303,608	241.4	47.0	132.3
Class X	798,151	559,853	261,654	205.0	42.6	114.0
Class Y	237,990	144,662	38,949	511.0	64.5	271.4
Class Z	379	746	3,005	......	......	......
Freight	10,165,616	5,231,215	1,038,097	879.3	94.3	403.9
Class X	7,547,669	4,077,049	834,233	804.7	85.1	388.7
Class Y	2,529,931	1,121,752	182,076	......	......	......
Class Z	88,016	32,414	21,788	......	......	......
Mail	723,640	646,575	432,080	67.5	11.9	49.6
Class X	631,994	577,721	409,376	54.4	9.4	41.1
Class Y	89,596	68,478	20,623	334.4	30.8	232.0
Class Z	2,050	376	2,081	......	......	......
Baggage, express, and milk[3]	3,687,947	1,560,802	401,672	818.1	136.3	288.6
Class X	2,465,056	1,139,824	378,693	55.1	116.3	201.0
Class Y	1,214,906	413,975	17,560	......	......	......
Class Z	7,985	7,003	5,419	......	......	......
Other transportation revenue[4]	1,919,413	......	......	......	......	......
Class X	1,516,984	......	......	......	......	......
Class Y	400,314	......	......	......	......	......
Class Z	2,115	......	......	......	......	......
Sale of electric current	36,500,030	20,093,302	7,703,574	373.8	81.7	160.8
Class X	5,465,104	3,504,084	1,196,025	356.9	56.0	193.0
Class Y	30,948,468	16,530,807	6,445,542	380.2	87.2	156.5
Class Z	86,458	58,411	62,007	......	......	......
Other nontransportation revenue[5]	10,826,901	7,818,209	3,853,420	180.1	38.5	102.9
Class X	8,952,942	6,592,307	3,517,604	154.5	35.8	87.4
Class Y	1,852,623	1,206,581	299,322	518.9	53.5	303.1
Class Z	21,336	19,321	36,494	......	......	......

[1] A minus sign (—) denotes decrease.
[2] Reported as "Chartered cars" in 1907 and 1902.
[3] Reported as " Express cars" in 1907 and 1902.
[4] Included in revenues from "Miscellaneous sources" in 1907 and 1902.
[5] Reported as revenue from "Miscellaneous sources" in 1907 and 1902.

Table 98 gives the percentage distribution of the items shown in Table 97.

As before explained, the income from the sale of electric current reported by companies without commercial lighting, though considerable in the aggregate, represents in the main sales of power to affiliated electric railway companies for traction purposes. Although the proportion it formed of the total income for companies of class X was slightly larger in 1912 than in former years, it constituted but 1.2 per cent of the total operating revenue for that class, as compared with 29.6 per cent for class Y.

It will be seen from Table 98 that while the sale of current by companies of class Y results in a virtual transposition of the proportions of revenues from sale of current and from passenger service, as compared with the corresponding proportions for companies of class X, it does not appreciably affect the proportions for the other services, either severally or as a whole.

Table 98 PER CENT DISTRIBUTION OF OPERATING REVENUES, BY SOURCE, OF COMPANIES WITHOUT AND WITH COMMERCIAL LIGHTING (BASED ON TABLE 97).

ACCOUNT.	Class X. Companies without commercial lighting.			Class Y. Companies with commercial lighting.		
	1912	1907	1902	1912	1907	1902
PER CENT OF TOTAL.						
Number of companies	77.9	75.5	78.8	17.2	18.6	14.0
Operating revenues	81.4	83.2	90.1	18.4	16.5	8.9
Passenger	76.5	86.8	92.6	11.9	13.0	6.5
Parlor, chair, and special car	77.0	79.4	86.2	23.0	20.5	12.8
Freight	74.2	78.0	80.4	24.9	21.4	17.5
Mail	87.3	89.4	94.7	12.4	10.6	4.8
Baggage, express, and milk	66.8	73.0	94.3	32.9	26.5	4.4
Other transportation revenue	79.0	......	......	20.9	......	......
Sale of electric current	15.0	17.4	15.5	84.8	82.3	83.7
Other nontransportation revenue	82.7	84.3	91.3	17.1	15.4	7.8
PER CENT OF OPERATING REVENUES.						
Operating revenues	100.0	100.0	100.0	100.0	100.0	100.0
Passenger	94.1	95.3	97.0	64.4	71.8	68.3
Parlor, chair, and special car	0.2	0.2	0.1	0.2	0.2	0.2
Freight	1.6	1.2	0.4	2.4	1.6	0.8
Mail	0.1	0.2	0.2	(1)	0.1	0.1
Baggage, express, and milk	0.5	0.3	0.2	1.2	0.6	0.1
Other transportation revenue	0.3	......	......	0.4	......	......
Sale of electric current	1.2	1.0	0.5	29.6	24.0	29.2
Other nontransportation revenue	1.9	1.9	1.6	1.8	1.7	1.3

[1] Less than one-tenth of 1 per cent.

Operating revenues of companies classified as "Elevated and subway" and "Surface."—Tables 99 and 100 present similar statistics for the groups of "Elevated and subway" and "Surface" companies, the former giving the operating revenues, by source, for the two classes of companies for 1912 and 1907, with per cent of increase for the 5-year period, and the latter the per cent distribution of the items contained in the former.

Table 99 OPERATING REVENUES OF COMPANIES CLASSIFIED AS "ELEVATED AND SUBWAY" AND "SURFACE."

ACCOUNT AND CLASS.	1912	1907	Per cent of increase.[1]
Number of companies	975	939	3.8
Elevated and subway	7	6	16.7
Surface	968	933	3.8
Operating revenues	$567,511,704	$418,187,858	35.7
Elevated and subway	52,238,727	33,874,054	54.2
Surface	515,272,977	384,313,804	34.1
Passenger	502,651,637	382,132,494	31.5
Elevated and subway	50,327,764	31,601,516	59.3
Surface	452,323,873	350,530,978	29.0
Parlor, chair, and special car[2]	1,036,520	705,261	47.0
Elevated and subway	1,074	......	......
Surface	1,035,446	705,261	46.8
Freight	10,165,616	5,231,215	94.3
Elevated and subway	29,003	......	......
Surface	10,136,613	5,231,215	93.8
Mail	723,640	646,575	11.9
Elevated and subway	608	17,948	−96.6
Surface	723,032	628,627	15.0
Baggage, express, and milk[3]	3,687,947	1,560,802	136.3
Elevated and subway	12,558	31,721	−60.4
Surface	3,675,389	1,529,081	140.4
Other transportation revenue[4]	1,919,413	......	......
Elevated and subway	223,612	......	......
Surface	1,695,801	......	......
Sale of electric current	36,500,030	20,093,302	81.7
Elevated and subway	387,273	107,775	259.3
Surface	36,112,757	19,985,527	80.7
Other nontransportation revenue[5]	10,826,901	7,818,209	38.5
Elevated and subway	1,256,835	2,115,094	......
Surface	9,570,066	5,703,115	......

[1] A minus sign (—) denotes decrease.
[2] Reported as "Chartered cars" in 1907.
[3] Reported as "Express cars" in 1907.
[4] Included in revenues from "Miscellaneous sources" in 1907.
[5] Reported as revenue from "Miscellaneous sources" in 1907.

Table 100 PER CENT DISTRIBUTION OF OPERATING REVENUES OF COMPANIES CLASSIFIED AS "ELEVATED AND SUBWAY" AND "SURFACE" (BASED ON TABLE 99).

ACCOUNT.	Per cent of total.				Per cent of operating revenues.			
	Elevated and subway.		Surface.		Elevated and subway.		Surface.	
	1912	1907	1912	1907	1912	1907	1912	1907
Number of companies	0.7	0.6	99.3	99.4	......	......	......	......
Operating revenues	9.2	8.1	90.8	92.9	100.0	100.0	100.0	100.0
Passenger	10.0	8.3	90.0	91.7	96.3	93.3	87.8	91.2
Parlor, chair, and special car	0.1	......	99.9	100.0	(1)	......	0.2	0.2
Freight	0.3	......	99.7	100.0	0.1	......	2.0	1.4
Mail	0.1	2.8	99.9	97.2	(1)	0.1	0.1	0.2
Baggage, express, and milk	0.3	2.0	99.7	98.0	(1)	0.1	0.7	0.4
Other transportation revenue	11.7	......	88.3	......	0.4	......	0.3	......
Sale of electric current	1.1	0.5	98.9	99.5	0.7	0.3	7.0	5.2
Other nontransportation revenue	11.6	27.1	88.4	72.9	2.4	6.2	1.9	1.5

(1) Less than one-tenth of 1 per cent.

As the elevated and subway group is typical rather than comprehensive, the principal interest of the statistics lies in the per cent distribution of the revenues rather than in the absolute amounts. Aside from miscellaneous earnings from advertising, rents, etc., the passenger receipts are practically the only source of revenue of the elevated and subway lines.

Miscellaneous income.—The term "miscellaneous income" is used to designate all income from other than operating sources. In 1912 the miscellaneous income of operating companies amounted to $18,418,813, as compared with $11,556,396 in 1907, an increase of 59.4 per cent. It constituted 3.1 per cent of the gross income in 1912, as compared with 2.7 per cent in 1907. Table 101 gives the statistics relating to miscellaneous income for 1912 and 1907, by geographic divisions.

Table 101 MISCELLANEOUS INCOME OF OPERATING COMPANIES, BY SOURCE AND BY GEOGRAPHIC DIVISIONS: 1912 AND 1907.

DIVISION.	Census.	Total.	Interest on bonds and dividends on stock of other electric railways.	Income from other permanent investments.	Other miscellaneous income.
United States	1912	$18,418,813	$7,182,933	$4,315,624	$6,920,256
	1907	11,556,396	3,255,618	4,972,164	3,328,614
New England	1912	907,934	91,913	103,893	712,128
	1907	331,560	27,807	127,484	176,269
Middle Atlantic	1912	6,362,082	1,759,690	1,360,285	3,242,107
	1907	3,069,326	1,174,081	552,584	1,342,661
East North Central	1912	3,985,314	1,527,733	1,218,350	1,239,231
	1907	2,269,156	547,225	1,010,318	711,613
West North Central	1912	297,899	80,455	71,671	145,773
	1907	231,263	500	85,756	145,007
South Atlantic	1912	1,910,462	307,766	1,093,720	508,976
	1907	1,072,998	115,253	795,093	162,652
East South Central	1912	477,776	251,954	199,341	26,481
	1907	242,952	20,674	204,078	18,200
West South Central	1912	1,823,251	1,550,516	1,134	271,601
	1907	1,561,431	759,992	759,050	42,389
Mountain	1912	848,117	753,542	39,174	55,401
	1907	523,493	306,974	140,910	75,609
Pacific	1912	1,805,978	859,364	228,056	718,558
	1907	2,254,217	303,112	1,296,891	654,214

The total ($7,182,933) received from interest on bonds and dividends on stock of other electric railways in 1912 represents an average return of 3.48 per cent on the value of the securities as reported in the balance-sheet statement of the companies, namely, $206,298,309. The "Income from other permanent investments" consists of the returns to the railway companies on other investments of all sorts. The amount of this income ($4,315,624) represents an average rate of 4.41 per cent on a total reported investment of $97,956,682.

The income from sources other than those specified, designated as "Other miscellaneous income," includes interest on deposits and loans, office rentals, etc. Table 102 presents the miscellaneous income of operating companies for 1912, 1907, and 1902, by income classes, and Table 103 the distribution of miscellaneous income among the income classes for 1912, by source.

Table 102 MISCELLANEOUS INCOME OF OPERATING COMPANIES, CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS.

CLASS.	1912	1907	1902	Per cent of total.		
				1912	1907	1902
Total—All companies	$18,418,813	$11,556,396	$2,950,628	100.0	100.0	100.0
Class A—$1,000,000 and over	13,616,088	6,008,657	2,585,249	73.9	52.0	87.6
Class B—$250,000 but less than $1,000,000	2,743,982	2,654,409	113,687	14.9	23.0	3.8
Class C—Less than $250,000	2,058,743	2,893,330	251,692	11.2	25.0	8.6

Table 103 MISCELLANEOUS INCOME, BY SOURCE, OF OPERATING COMPANIES, CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS: 1912.

CLASS.	Total.	Interest on bonds and dividends on stock of other electric railways.	Income from other permanent investments.	Other miscellaneous income.
Total—All companies	$18,418,813	$7,182,933	$4,315,624	$6,920,256
Class A—$1,000,000 and over	13,616,088	5,348,335	2,584,522	5,683,231
Class B—$250,000 but less than $1,000,000	2,743,982	849,718	1,205,489	688,775
Class C—Less than $250,000	2,058,743	984,880	525,613	548,250

OPERATING EXPENSES.

The factors influencing operating expenses are many and varied. Differences in character of system, whether electric or other, and if electric, whether overhead trolley, conduit, or third rail, or operated without line transmission by gas-electric motors or storage batteries; differences in respect to power whether generated or purchased, and if generated, whether by steam or water; differences in character of roadbed and rolling stock, in character of territory traversed, etc., all affect the cost of maintenance and operation. In no two cases are the conditions identical, and comparisons for different years or between groups of companies are of interest and value only as illustrating general conditions.

The operating cost per unit is commonly used in judging efficiency of management, but the fixed and overhead charges have to be taken into account in judging of the profitableness of railway properties. A comparison of operating expenses and revenues, reduced to units of equipment and traffic, will be found in the section on "General results of operation" (p. 256).

Operating expenses, in accordance with the standard classification of accounts of electric railways prescribed by the Interstate Commerce Commission, are classified under five general accounts: "Way and structures," "Equipment," "Traffic," "Conducting transportation," and "General and miscellaneous." Under these are the various primary accounts, a synopsis of which follows:

I. WAY AND STRUCTURES.

Superintendence of way and structures.—This account includes salaries and office and traveling expenses of officers and their assistants when directly in charge of maintenance of way and structures, including chief engineer, engineer of maintenance of way, superintendent of electric lines, superintendent of buildings, architect, division engineer, roadmasters, track foremen, and office and field forces; cost of drafting and engineering instruments and repairing same; cost of supplies used by employees whose salaries are charged to this account; office rent, cost of repairing rented offices, and miscellaneous office expenses when separate offices are maintained by officers whose salaries are charged to this account.

Maintenance of way.—This account includes all expense, whether for material or labor, pertaining to maintenance of roadway and track, ballast, ties, rails, rail fastenings or joints; special work; underground construction for roads operated by underground electric contact system or cable; paving; roadway tools; cleaning and sanding track; removal of snow, ice, and sand; and repairing tunnels and subways, elevated structures and foundations, bridges, trestles and culverts, crossings, fences, cattle guards and signs, signal and interlocking systems, and telephone and telegraph systems owned by the railway.

Maintenance of electric lines.—This account includes the material and labor expense pertaining to the maintenance and renewal of poles and fixtures, underground conduits for wires and cables, transmission systems, and distribution systems.

Buildings and structures.—This account includes cost of material and labor expended in repairing and renewing buildings and structures used in the operation of the road; cost of fixtures and repairs and renewals of same; cost of maintaining walks, driveways, and grounds connected with buildings; cost of delivering material, including freight charges, if any; and all incidental expenses connected with the maintenance of buildings and structures.

Depreciation of way and structures.—This account includes depreciation of way and structures when carried as an operating expense, in which case charges for renewals should be excluded from all accounts affected by the introduction of this account. Such expenditures for renewals are then to be charged direct to an appropriate replacement account maintained by the prescribed charges to this account.

Other operations.—This account includes the proportion of operating expenses chargeable to maintenance of way and structures of the railway department, but the distributed charges for which are made to the primary accounts of another coordinate department, such as electric light, heat, or power, within the same company.

II. EQUIPMENT.

Superintendence of equipment.—This account includes all expense pertaining to superintendence of equipment (see "Superintendence of way and structures").

Maintenance of power equipment.—This account includes cost of material used and labor expended in repairing and renewing power-plant equipment and substation or subsidiary equipment, including switchboards, cables, and feeder terminals, and wiring in connection with same.

Maintenance of cars and locomotives.—This account includes the repairing and renewal of all cars and locomotives, including all fixtures and appliances of or attached to the car body or truck (except the electric equipment) and the cost of shifting trucks.

Maintenance of electric equipment of cars and locomotives.—This account includes cost of material used and labor expended in repairing and renewing the electric equipment and wiring of cars and locomotives, and cost of shifting the electric equipment from one to another.

Miscellaneous equipment expenses.—This account includes all expense for repairing and renewing shop machinery and tools; the lighting and heating of repair shops and other shop expenses; wages of stationary engineers and firemen and unskilled laborers employed in general work in and about shops and shopyards; also cost of repairing and renewing harness and vehicles, including cost of horses purchased to replace others lost by death or worn out in service, etc.

Depreciation of equipment.—(See "Depreciation of way and structures.")

Other operations.—(See "Other operations" under "Way and structures.")

III. TRAFFIC.

This account includes expenses pertaining to superintendence and solicitation of traffic and advertising; salaries and office and traveling expenses of officers and their assistants, including traffic managers, when directly in charge of traffic; cost of supplies used by employees whose salaries are charged to this account; office rent and cost of repairing rented offices, and miscellaneous office expenses when separate offices are maintained by officers whose salaries are charged to this account; salaries and expenses of advertising agents; cost of bill posting, and printing, publishing, and distributing advertising matter; advertising in newspapers and periodicals for the purpose of securing traffic; bulletin boards, cards, cases, display cards, photographs, and postage and express charges on advertising matter; net expense of music, parks, park properties, and resorts (after deducting all income from admittance fees, sale of privileges, etc.), when such expense is incurred primarily for the purpose of attracting traffic and not as an investment; donations made for traffic purposes, and other expenses for attracting traffic; and the expense of traffic associations.

IV. CONDUCTING TRANSPORTATION.

Superintendence of transportation.—This account includes all expense pertaining to superintendence of transportation (see "Superintendence of way and structures").

Power.

Power-plant employees.—This account includes all expenditures for labor in power plants, except labor employed in making repairs and renewals.

Substation employees.—This account includes all expenditures for labor in substations, except labor employed in making repairs and renewals.

Fuel for power.—This account includes all expenditures for coal, oil, gas, and other fuel used at power plants, including transportation.

Other power supplies and expenses.—This account includes all expenditures for water used to produce steam or to operate a water-power plant; for pumping; for rent of ponds, streams, and pipe lines; for water rents; for boiler compounds, lubricants, waste, carbon brushes, fuses, and lamps; and for other supplies and expenses of power plants and stations.

Power purchased.—This account includes all expenditures for power purchased from other companies.

Power exchanged—balance.—This account includes the net debit or credit balance in cases where power is received from and delivered to other companies.

Other operations.—(See "Other operations" under "Way and structures.")

Operation of cars.

Conductors, motormen, and trainmen.—This account includes wages of all conductors, motormen, and other trainmen, whether engaged in passenger, freight, express, or mail service.

Miscellaneous transportation expenses.—This account includes wages of transfer agents, switch tenders, switchmen, flagmen, watchmen, trail-car couplers, bridge tenders, and other miscellaneous car-service employees: all expenditures for lubricants and waste for cars and electric equipment of cars; incandescent lamps, oil, and other supplies for lighting cars; supplies for cleaning cars; fuel for heating cars; tools and other materials and supplies, except such as are used for repairs or renewals; cost of tickets, transfers, and baggage checks; secret inspection; conductors' books and punches; portable registers; tools for motormen; car-service employees' badges and uniforms, and all other car-service supplies and expenses: all *station expense*, including wages of station masters, of freight, express, ticket, baggage, and other station agents, and of announcers, station gatemen, choppermen, platform men, janitors, porters, watchmen, and other station employees; wages of warehousemen, freight-house foremen, truckmen, checkmen, and other express and freight-house employees; all expenditures for heating and lighting stations, waiting rooms, freight houses, and other station buildings; rent of station buildings; cost of furniture, of tools and implements for handling freight and baggage, and of station employees' uniforms and badges; and outlays for water, ice, and all other station expenses: all *car-house expense*, including wages of car-house foremen, watchmen, car placers, and car shifters, of car, motor, and brake inspectors, and of car cleaners, lamp and headlight tenders, car oilers, car-stove firemen, trolley oilers, and other car-house employees not engaged in making repairs or renewals; and all car-house supplies and expenses: wages of employees engaged in operating *signal and interlocking systems* covering the movement of cars, such as towermen, signalmen, levermen, and lampmen; and cost of supplies used in operating signal and interlocking systems, and supplies for signal offices: wages of *telephone and telegraph operators;* cost of supplies for telephone and telegraph service; payments for use of telephone and telegraph lines; and other telephone and telegraph expenses in connection with transportation: wages of drivers and helpers employed on wagons used for the *collection and delivery of express matter;* amounts paid for handling express matter in wagons or other vehicles; and other expenses incident to the collection and delivery of express matter: all expenditures for *loss, damage, delays, and destruction of freight, express, and baggage* intrusted to a carrier for transportation, and expenses directly incident thereto; and cost of getting derailed cars on track and removing obstructions and wreckage: and all other expenses in connection with conducting transportation not properly chargeable to other accounts.

V. GENERAL AND MISCELLANEOUS.

General expenses.—This account includes salaries and traveling and incidental expenses of chairman of the board, president, vice president, treasurer, secretary, comptroller, auditor, general manager, assistant general manager, chief engineer, general superintendent, purchasing agent, and all other officers when their jurisdiction extends over the entire system; salaries and traveling and incidental expenses of traveling auditors, bookkeepers, cashiers, paymasters, stenographers, and clerks employed in counting cash, tickets, transfers, etc.: outlays for *office supplies and expenses;* repairs and renewals of office furniture; wages of janitors, porters, and messengers; rent, and all other miscellaneous expenses of general offices: *law expenses* (except those incurred in the defense and settlement of damage claims), including salaries and expenses of all counsel, solicitors, and attorneys, their clerks and attendants, and expenses of their offices; cost of law books, printing briefs, legal forms, testimony, reports, etc.; fees and retainers for services of attorneys not regular employees; court costs and payments of special, notarial, and witness fees; expenses connected with taking depositions; and all law and court expenses not provided for elsewhere: salaries and expenses incurred in connection with conducting a *relief department*, and contributions made to such department: *pensions* paid to retired employees, and expenses in connection therewith; and the cost of telephone service, telegrams, gratuities, subscriptions, donations (except those provided for under "Traffic"), and other miscellaneous expenses connected with the general management not otherwise provided for.

Other operations.—(See "Other operations" under "Way and structures.")

Injuries and damages.—This account includes all expenditures on account of persons killed or injured and property damaged; salaries and expenses of claim agents, investigators, adjusters, and others engaged in the investigation of accidents and adjustment of claims; salaries, fees, and expenses of surgeons and doctors; expenditures for nursing, hospital attendance, and medical and surgical supplies; fees and expenses of coroners and undertakers; fees of witnesses and others; law expenses incurred in connection with the defense or settlement of damage claims, including the compensation of general solicitor or counsel; salaries, fees, and expenses of attorneys; fees of court stenographers; cost of law books, printing of briefs, court and other records; court costs; expenses connected with taking depositions; and all other like expenses connected with the settlement of claims for injuries and damages; but does not include expenses incurred in connection with the settlement of claims for loss, damage, or delay of goods intrusted for transportation (see "Miscellaneous transportation expenses").

Insurance.—This account includes premiums paid to insurance companies for fire, fidelity, boiler, casualty, burglary, and all other insurance. The amount set aside as an insurance reserve by a company carrying its own insurance in whole or in part should be charged to this account.

Stationery and printing.—This account includes expenditures for stationery and printing, including postage, and for stationery supplies not elsewhere provided for.

Store and stable expenses.—This account includes all salaries and expenses in connection with storerooms, including cost of sending material and supplies from general storerooms to branch storerooms, and of collecting scrap material; cost of feed, keep, and shoeing of horses; wages of stablemen and hostlers; veterinary expenses; and all other stable expenses. This account should include the stable expenses of all horses regardless of where they are used. (The replacement of horses lost by death or worn out in service, and repair and renewal of harness and vehicles are charged to "Miscellaneous equipment expenses.")

Rent of tracks and terminals.—This account includes payments to other companies for rent or use of their tracks, whether on the basis of a fixed charge per month or per year, or a proportion of interest on valuation, or a proportion of expenses incurred in maintaining and operating such tracks, or car mileage, or a charge per car or per passenger, or under any other arrangement; also payments for use of facilities at terminal points, including main and other tracks and freight-house facilities, proportion of expenses of handling freight, union station facilities, etc. (Rent of leased line not operated by the lessor company is treated as a deduction from income under "Rent of leased lines and terminals.")

Rent of equipment.—This account includes payments to other companies for rent or use of their cars, of electric equipment of cars, and of other equipment.

Table 162 (p. 311) gives the statistics of operating expense by general accounts, for 1912, 1907, and 1902, by geographic divisions and states, and Table 163 (p. 314) the statistics of operating expense by primary accounts, for 1912, by geographic divisions and states. Table 104 is a comparative summary for the industry as a whole for the three years, and Table 105 gives the per cent distribution of accounts.

STREET AND ELECTRIC RAILWAYS—OPERATING EXPENSES, BY ACCOUNTS: 1912, 1907, AND 1902.

Table 104

ACCOUNT.	1912	1907	1902	PER CENT OF INCREASE.[1]	
				1907–1912	1902–1907
Number of companies	975	939	799	3.8	17.5
Operating expenses	$332,896,356	$251,309,252	$142,312,597	32.5	76.6
GENERAL ACCOUNTS.					
Way and structures	46,371,685	28,520,925	13,600,236	62.6	109.7
Equipment	40,056,378	31,485,810	16,676,532	27.2	88.8
Traffic	2,606,057	[2] 1,730,851	[2] 1,122,816	(3)	54.2
Conducting transportation	189,689,432	141,095,350	84,035,067	34.4	67.9
Superintendence of transportation	7,127,204	3,545,418	2,598,935	101.0	36.4
Power	60,484,917	43,972,669	23,062,328	37.6	90.7
Operation of cars	122,077,311	93,577,263	58,373,804	30.5	60.3
General and miscellaneous	54,172,804	42,307,443	24,689,193	28.0	71.4
Wages, supplies, and expenses incident to electric service, not elsewhere included	....	6,168,873	2,188,753	....	181.8
PRIMARY ACCOUNTS.					
Way and structures:					
Superintendence of way and structures	2,579,774	....	....	....	....
Maintenance of way	30,162,653	21,824,113	9,640,571	(3)	126.4
Maintenance of electric lines	5,513,272	4,777,697	2,959,182	(3)	61.5
Buildings and structures	2,674,899	1,919,115	1,000,483	(3)	91.8
Depreciation of way and structures	3,705,511	....	....	....	....
Other operations [4]	1,735,576	....	....	....	....
Equipment:					
Superintendence of equipment	1,672,393	....	....	....	....
Maintenance of power equipment	3,769,735	3,834,017	2,180,393	(3)	75.9
Maintenance of cars and locomotives	16,936,623	13,814,296	7,659,428	(3)	80.4
Maintenance of electric equipment of cars and locomotives	9,877,340	10,753,321	5,325,125	(3)	101.9
Miscellaneous equipment expenses	3,039,164	3,084,176	1,511,586	(3)	104.0
Depreciation of equipment	3,670,376	....	....	....	....
Other operations [4]	1,090,747	....	....	....	....
Traffic expenses	2,606,057	[2] 1,730,851	[2] 1,122,816	(3)	54.2
Conducting transportation:					
Superintendence of transportation	7,127,204	3,545,418	2,598,935	101.0	36.4
Power—					
Power-plant employees	6,325,506	7,876,355	4,599,487	3.6	71.2
Substation employees	1,831,196				
Fuel for power	20,145,466	21,058,259	12,827,322	−4.3	64.2
Other power supplies and expenses	2,021,521	2,695,797	1,764,001	−25.0	52.8
Power purchased	24,696,647	12,342,258	3,871,518	100.1	218.8
Other operations [4]	5,464,581	....	....	....	....
Operation of cars—					
Conductors, motormen, and trainmen	98,185,596	74,836,506	48,733,793	31.2	53.6
Miscellaneous transportation expenses	23,891,715	18,740,757	9,640,011	27.5	94.4
General and miscellaneous:					
General expenses	19,133,239	15,173,728	9,585,862	26.1	58.3
Injuries and damages	20,707,960	18,176,305	9,395,545	13.9	93.5
Insurance	3,151,576	3,137,071	2,080,875	0.5	50.8
Stationery and printing	1,105,422	838,562	496,381	31.8	68.9
Store and stable expenses	2,040,409	1,639,162	1,659,237	24.5	−1.2
Rent of tracks and terminals	3,676,337	2,768,786	1,471,293	32.8	88.2
Rent of equipment	1,197,022	573,829	(5)	108.6	....
Other operations [4]	3,160,839	....	....	....	....
Wages, supplies, and expenses incident to electric service, not elsewhere included [4]	....	6,168,873	2,188,753	....	181.8

[1] A minus sign (−) denotes decrease.
[2] Advertising and attractions only.
[3] Not comparable.
[4] Expenses of light and power departments not distributed among prior accounts.
[5] Not reported separately.

The increase in the total operating expenses from 1907 to 1912 was $81,587,104, or 32.5 per cent, as compared with an increase of $149,323,846, or 35.7 per cent, in operating revenues, the rate of increase in revenues being slightly greater than that in expenses. On the other hand, for the period 1902–1907 the percentage of increase in operating expenses (76.6) materially exceeded that in operating revenues (68.9).

Of the more important items, the per cent of increase in purchased power is conspicuously large. On account of changes in the classification of accounts, not all of the primary accounts as reported in 1912 and 1907 are strictly comparable, but it is apparent that the increase in cost of maintenance of way has been especially large. The apparent decrease in expenses for maintenance of electric equipment of cars and locomotives and for miscellaneous equipment, in 1912 as compared with 1907, is due to bookkeeping changes, for equipment expense as a whole increased 27.2 per cent. The decrease in "Fuel for power" and "Other power supplies and expenses" for the last half decade is due in part to the change from generation to the purchase of power on the part of many companies. The decrease in the ratio for "Injuries and damages," which item constituted 6.2 per cent of operating expenses in 1912, as compared with 7.2 per cent in 1907 and 6.6 per cent in 1902, indicates a material betterment since 1907 of conditions bearing upon the safety of passengers, employees, and others. The average expense for injuries and damages per revenue passenger carried was 0.217 of a cent in 1912, as compared with 0.244 in 1907 and 0.197 in 1902. Referred to a basis of passenger revenue, 4.1 per cent went to pay injuries and damages in 1912, 4.8 per cent in 1907, and 4 per cent in 1902.

Table 105

PER CENT DISTRIBUTION OF OPERATING EXPENSES, BY ACCOUNTS (BASED ON TABLE 104).

ACCOUNT.	Operating expenses.			General accounts.		
	1912	1907	1902	1912	1907	1902
Operating expenses	100.0	100.0	100.0	......	......	......
Way and structures	13.9	11.4	9.6	100.0	100.0	100.0
Superintendence of way and structures	0.8	......	......	5.6	......	......
Maintenance of way	9.1	8.7	6.8	65.0	76.5	70.9
Maintenance of electric lines	1.7	1.9	2.1	11.9	16.8	21.8
Buildings and structures	0.8	0.8	0.7	5.8	6.7	7.3
Depreciation of way and structures	1.1	......	......	8.0	......	......
Other operations	0.5	......	......	3.7	......	......
Equipment	12.0	12.5	11.7	100.0	100.0	100.0
Superintendence of equipment	0.5	......	......	4.2	......	......
Maintenance of power equipment	1.1	1.5	1.5	9.4	12.2	13.1
Maintenance of cars and locomotives	5.1	5.5	5.4	42.3	43.9	45.9
Maintenance of electric equipment of cars and locomotives	3.0	4.3	3.7	24.7	34.1	31.9
Miscellaneous equipment expenses	0.9	1.2	1.1	7.6	9.8	9.1
Depreciation of equipment	1.1	......	......	9.2	......	......
Other operations	0.3	......	......	2.7	......	......
Traffic expenses	0.8	0.7	0.8	......	......	......
Conducting transportation	57.0	56.1	59.1	100.0	100.0	100.0
Superintendence of transportation	2.1	1.4	1.8	3.8	2.5	3.1
Power	18.2	17.5	16.2	31.9	31.2	27.4
Power-plant employees	1.9	3.1	3.2	3.3	5.6	5.5
Substation employees	0.6			1.0		
Fuel for power	6.1	8.4	9.0	10.6	14.9	15.3
Other power supplies and expenses	0.6	1.1	1.2	1.1	1.9	2.1
Power purchased	7.4	4.9	2.7	13.0	8.7	4.6
Other operations	1.6	......	......	2.9	......	......
Operation of cars	36.7	37.2	41.0	64.4	66.3	69.5
Conductors, motormen, and trainmen	29.5	29.8	34.2	51.8	53.0	58.0
Miscellaneous transportation expenses	7.2	7.5	6.8	12.6	13.3	11.5
General and miscellaneous	16.3	16.8	17.3	100.0	100.0	100.0
General expenses	5.7	6.0	6.7	35.3	35.9	38.8
Injuries and damages	6.2	7.2	6.6	38.2	43.0	38.1
Insurance	0.9	1.2	1.5	5.8	7.4	8.4
Stationery and printing	0.3	0.3	0.3	2.0	2.0	2.0
Store and stable expenses	0.6	0.7	1.2	3.8	3.9	6.7
Rent of tracks and terminals	1.1	1.1	1.0	6.8	6.5	6.0
Rent of equipment	0.4	0.2	......	2.2	1.4	......
Other operations	1.0	......	......	5.8	......	......
Wages, supplies, and expenses incident to electric service, not elsewhere included	......	2.4	1.5	......	......	......

Operating expenses of companies classified according to income from railway operations.—Table 106 shows, for 1912, the general operating expense accounts for companies classified according to income from railway operations, and Table 107 gives, for 1912, the per cent distribution of operating expenses, by class and by accounts. Figures are not available for 1907 and 1902 which are comparable, as to accounts, with those for 1912.

The percentages of operating expenses represented by the several accounts show some variations for the different classes. Companies of class A show the largest proportion of operating expense consumed in maintenance of way and structures, equipment, superintendence of transportation, and operation of cars; while those of class C stand highest for power and general and miscellaneous expense, companies of class B falling into line between those of the other two classes in each case. Economies in power expense and in general management accompany growth in size. The large urban systems operating in congested districts are in classes A and B, and this fact undoubtedly accounts for the relatively low ratios for cost of power and for general and miscellaneous expenses shown by companies in these classes.

Table 106

OPERATING EXPENSES BY ACCOUNTS—COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS: 1912.

ACCOUNT.	Total.	Class A. $1,000,000 and over.	Class B. $250,000 but less than $1,000,000.	Class C. Less than $250,000.
Number of companies	975	91	155	729
Operating expenses	$332,896,356	$239,739,927	$53,250,043	$39,906,386
Way and structures	46,371,685	33,639,324	7,399,478	5,332,883
Equipment	40,056,378	29,934,214	5,811,139	4,311,025
Traffic	2,606,057	1,343,813	755,013	507,231
Conducting transportation	189,689,432	137,849,515	29,733,036	22,106,881
Superintendence of transportation	7,127,204	5,500,233	983,641	643,330
Power	60,484,917	38,963,303	11,345,267	10,176,347
Operation of cars	122,077,311	93,385,979	17,404,128	11,287,204
General and miscellaneous	54,172,804	36,973,061	9,551,377	7,648,366

Table 107

PER CENT DISTRIBUTION OF OPERATING EXPENSES BY ACCOUNTS—COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS: 1912 (BASED ON TABLE 106).

ACCOUNT.	Per cent of total.			Per cent of operating expenses.			
	Class A.	Class B.	Class C.	Total.	Class A.	Class B.	Class C.
Number of companies	9.3	15.9	74.8	......	......	......	......
Operating expenses	72.0	16.0	12.0	100.0	100.0	100.0	100.0
Way and structures	72.5	16.0	11.5	13.9	14.0	13.9	13.4
Equipment	74.7	14.5	10.8	12.0	12.5	10.9	10.8
Traffic	51.6	29.0	19.5	0.8	0.6	1.4	1.3
Conducting transportation	72.7	15.7	11.7	57.0	57.5	55.8	55.4
Superintendence of transportation	77.2	13.8	9.0	2.1	2.3	1.8	1.6
Power	64.4	18.8	16.8	18.2	16.3	21.4	25.5
Operation of cars	76.5	14.3	9.2	36.7	39.0	32.7	28.3
General and miscellaneous	68.3	17.6	14.1	16.3	15.4	17.9	19.2

Operating expenses of companies without and with commercial lighting.—A grouping of the operating expenses of companies, classified as "Without commercial lighting," "With commercial lighting," and "Miscellaneous," for 1912, is given in Table 108, and percentages of distribution based thereon are shown in Table 109. Comparable statistics for 1907 and 1902 are not available.

Table 108

OPERATING EXPENSES, BY ACCOUNTS—COMPANIES WITHOUT AND WITH COMMERCIAL LIGHTING: 1912.

ACCOUNT.	Total.	Class X. Without commercial lighting.	Class Y. With commercial lighting.	Class Z. Miscellaneous.
Number of companies	975	760	168	47
Operating expenses	$332,896,356	$273,622,168	$58,520,068	$754,120
Way and structures	46,371,685	37,976,257	8,316,381	79,047
Equipment	40,056,378	33,275,115	6,714,229	67,034
Traffic	2,606,057	2,012,865	579,887	13,305
Conducting transportation	189,689,432	158,007,341	31,241,842	440,249
Superintendence of transportation	7,127,204	6,139,477	973,143	14,584
Power	60,484,917	46,855,106	13,424,184	205,627
Operation of cars	122,077,311	105,012,758	16,844,515	220,038
General and miscellaneous	54,172,804	42,350,590	11,667,729	154,485

Table 109 PER CENT DISTRIBUTION OF OPERATING EXPENSES, BY ACCOUNTS—COMPANIES WITHOUT AND WITH COMMERCIAL LIGHTING: 1912 (BASED ON TABLE 108).

ACCOUNT.	Per cent of total.			Per cent of operating expenses.		
	Class X.	Class Y.	Class Z.	Total.	Class X.	Class Y.
Number of companies	78.0	17.2	4.8	......	......	......
Operating expenses	82.2	17.6	0.2	100.0	100.0	100.0
Way and structures	81.9	17.9	0.2	13.9	13.9	14.2
Equipment	83.0	17.8	0.2	12.0	12.2	11.5
Traffic	77.2	22.3	0.5	0.8	0.7	1.0
Conducting transportation	83.3	16.5	0.2	57.0	57.7	53.4
Superintendence of transportation	86.1	13.7	0.2	2.1	2.2	1.7
Power	77.5	22.2	0.3	18.2	17.1	22.9
Operation of cars	86.0	13.8	0.2	36.7	38.4	28.9
General and miscellaneous	78.2	21.5	0.3	16.3	15.5	19.9

Power expense is naturally a somewhat more important item of expense for companies of class Y than those of class X, while operation of cars represents but 28.9 per cent of operating expenses for class Y, as compared to 38.4 per cent for class X.

Operating expenses of companies classified as "Elevated and subway" and "Surface."—Table 110 presents the leading operating statistics for the "Elevated and subway" and "Surface" groups for 1912.

The expenses of equipment maintenance and of conducting transportation are proportionately high for the elevated and subway lines; and, conversely, outlays for maintenance of way and structures and general and miscellaneous expense are relatively low.

Table 110 OPERATING EXPENSES, BY ACCOUNTS—COMPANIES CLASSIFIED AS "ELEVATED AND SUBWAY" AND "SURFACE:" 1912.

ACCOUNT.	Total.	Elevated and subway.	Surface.	Per cent of operating expenses.	
				Elevated and subway.	Surface.
Number of companies	975	7	968	....	....
Operating expenses	$332,896,356	$23,612,867	$309,283,489	100.0	100.0
Way and structures	46,371,685	2,599,183	43,772,502	11.0	14.1
Equipment	40,056,378	3,874,365	36,182,013	16.4	11.7
Traffic	2,606,057	19,005	2,587,052	0.1	0.8
Conducting transportation	189,689,432	14,532,501	175,156,931	61.5	56.6
General and miscellaneous	54,172,804	2,587,813	51,584,991	11.0	16.7

DEDUCTIONS FROM INCOME.

The deductions from income shown in the census tables include taxes, interest, rent of leased lines and terminals, charges for sinking funds, and various miscellaneous deductions. In the standard form of accounting for electric railways adopted by the Interstate Commerce Commission and the American Electric Railway Accountants Association, salaries and maintenance of organization are included in operating expenses, and charges for permanent improvements are deductions from net income. Table 111 gives the statistics for deductions from income for all operating companies for 1912, 1907, and 1902.

Table 111 OPERATING COMPANIES—DEDUCTIONS FROM INCOME, BY ACCOUNTS.

ACCOUNT.	1912	1907	1902	Per cent of increase.[1]			Per cent distribution.		
				1902–1912	1907–1912	1902–1907	1912	1907	1902
Number of companies	975	939	799	22.0	3.8	17.5	....	....	....
Deductions from income	$191,123,408	$138,094,716	$77,595,053	146.3	38.4	78.0	100.0	100.0	100.0
Taxes	35,027,965	19,755,602	13,078,899	167.8	77.3	51.0	18.3	14.3	16.9
On real and personal property	15,658,239	9,464,616	5,835,542	168.3	65.4	62.2	8.2	6.9	7.5
On capital stock	3,899,146	2,348,439	2,931,252	33.0	66.0	−19.9	2.0	1.7	3.8
On earnings	9,486,792	5,437,028	2,719,287	248.9	74.5	99.9	5.0	3.9	3.5
Federal corporation tax	1,016,901	....	....	....	....	....	0.6	....	....
Miscellaneous	4,966,887	2,505,519	1,592,818	211.8	98.2	57.3	2.6	1.8	2.1
Interest on funded and floating debt and mortgages	98,025,338	63,740,744	38,085,911	157.4	53.8	67.4	51.3	46.2	49.1
Rent of leased lines and terminals	44,784,521	48,022,596	25,518,225	75.5	−6.8	88.2	23.4	34.8	32.9
Charges for sinking fund	6,229,136	(2)	(2)	....	....	....	3.3	....	....
Miscellaneous deductions	7,056,448	6,575,774	912,018	....	....	....	3.7	4.8	1.2

[1] A minus sign (—) denotes decrease.

[2] Included under "Miscellaneous deductions."

Deductions from income as a whole increased at the rate of 38.4 per cent for the period 1907–1912, as compared with 78 per cent for the preceding five-year interval, but taxes increased by 77.3 per cent and interest by 53.8 per cent during the later period.

Taxes.—Taxes represented 18.3 per cent of all deductions from income in 1912, as compared with 14.3 per cent in 1907 and 16.9 per cent in 1902, and the proportionate increase appears in every class of tax for 1912, as compared with either of the prior years, with the single exception of the tax on capital stock, which was 2 per cent of all deductions in 1912, as compared with 3.8 per cent in 1902.

This growth in the tax burden is specially marked when referred to the basis of income available for the payment of fixed charges. In 1912 taxes consumed 13.8 per cent of the gross income remaining after the payment of operating expenses, as compared with 11.1 per cent in 1907 and 12.1 per cent in 1902. The following statement shows this ratio of taxes to gross income less operating expenses, by geographic divisions:

DIVISION.	RATIO OF TAXES TO GROSS INCOME LESS OPERATING EXPENSES (PER CENT).		
	1912	1907	1902
United States	13.8	11.1	12.2
New England	21.1	17.2	19.4
Middle Atlantic	12.6	9.4	11.9
East North Central	15.2	11.2	10.7
West North Central	14.0	11.4	10.6
South Atlantic	11.9	11.6	11.6
East South Central	14.4	15.0	11.7
West South Central	10.4	9.3	13.1
Mountain	10.7	6.6	8.5
Pacific	12.2	11.5	10.0

In all the divisions, with the exception of the South Central, taxes consumed a larger proportion of the income left after paying operating expenses in 1912 than in either of the prior years, the proportion for the East South Central division being largest in 1907 and for the West South Central division in 1902. A marked feature is the very high ratio for the railways of the New England states.

Table 112 presents the statistics for deductions from income, by geographic divisions and states, for 1912, 1907, and 1902.

STREET AND ELECTRIC RAILWAYS—OPERATING COMPANIES—DEDUCTIONS FROM INCOME, BY ACCOUNTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902.

Table 112

DIVISION AND STATE.	Census.	Number of companies.	Total.	Taxes.	Interest.	Rent of leased lines and terminals.	Charges for sinking fund.[1]	Miscellaneous.
UNITED STATES	1912	975	$191,123,408	$35,027,965	$98,025,338	$44,784,521	$6,229,136	$7,056,448
	1907	939	138,094,716	19,755,602	63,740,744	48,022,596	...	6,575,774
	1902	799	77,595,053	13,078,899	38,085,911	25,518,225	...	912,018
GEOGRAPHIC DIVISIONS:								
New England	1912	91	14,062,569	4,237,429	4,639,940	4,943,924	54,273	187,003
	1907	118	11,454,167	2,632,264	3,635,477	4,031,369	...	1,155,057
	1902	137	7,054,630	2,035,656	2,882,605	2,108,160	...	28,209
Middle Atlantic	1912	246	75,286,805	11,249,018	30,679,925	2 ,908,785	1,824,521	1,624,556
	1907	247	60,453,506	6,149,629	16,891,258	35,106,326	...	2,306,293
	1902	219	36,046,981	5,436,849	13,962,704	16,208,237	...	439,191
East North Central	1912	222	45,893,986	9,211,636	25,000,144	6,219,368	2,099,581	3,363,257
	1907	220	29,409,640	4,616,994	16,229,354	7,770,335	...	792,957
	1902	177	16,662,311	2,653,112	8,673,771	4,941,643	...	393,785
West North Central	1912	85	11,225,491	2,490,045	8,102,645	177,948	123,223	331,630
	1907	73	10,394,107	1,789,058	7,033,298	115,499	...	1,456,252
	1902	58	6,306,643	868,578	3,158,091	2,254,228	...	25,746
South Atlantic	1912	107	13,277,195	2,353,998	7,826,289	2,395,330	161,332	540,246
	1907	100	7,998,784	1,548,424	5,982,598	345,370	...	122,392
	1902	75	5,260,379	806,718	4,437,607	2,695	...	13,359
East South Central	1912	45	4,727,566	1,105,753	3,438,560	11,698	83,913	87,642
	1907	40	3,763,689	833,731	2,780,485	...	...	149,473
	1902	34	1,796,235	332,896	1,458,580	...	...	4,759
West South Central	1912	79	5,139,540	883,447	3,414,904	551,667	197,999	91,523
	1907	50	3,195,729	545,055	2,278,835	320,449	...	51,390
	1902	32	957,934	244,288	707,016	...	...	6,630
Mountain	1912	40	3,729,066	589,860	2,468,536	179,312	387,366	103,992
	1907	28	1,911,327	238,304	1,563,607	...	...	109,416
	1902	18	787,361	109,762	674,228	3,262	...	109
Pacific	1912	60	17,781,190	2,906,779	12,454,395	396,489	1,296,928	726,599
	1907	63	9,513,767	1,402,143	7,345,832	333,248	...	432,544
	1902	49	2,722,579	591,040	2,131,309	...	...	230
NEW ENGLAND:								
Maine	1912	16	1,193,095	120,208	806,522	216,459	25,955	23,951
	1907	17	469,277	43,383	425,894	...	...	...
	1902	19	337,050	29,704	301,772	4,000	...	1,574
New Hampshire	1912	13	211,831	39,912	111,618	...	7,495	52,806
	1907	16	112,510	15,919	96,591	...	...	...
	1902	7	83,786	7,822	47,390	28,574	...	...
Vermont	1912	9	169,912	19,596	150,315	1	...	...
	1907	10	117,601	9,795	107,451	...	...	355
	1902	9	45,089	4,427	40,662	...	...	...
Massachusetts	1912	43	9,047,779	3,108,197	3,269,282	2,542,459	20,823	107,018
	1907	62	7,061,339	1,911,510	2,610,927	2,145,639	...	393,263
	1902	74	5,108,619	1,609,496	1,524,248	1,967,540	...	7,335
Rhode Island and Connecticut	1912	10	3,439,952	949,516	302,203	2,185,005	...	3,228
	1907	13	3,693,440	651,657	394,614	1,885,730	...	761,439
	1902	28	1,480,086	384,207	968,533	108,046	...	19,300
MIDDLE ATLANTIC:								
New York	1912	101	43,168,721	7,735,345	21,539,215	12,684,642	728,452	481,067
	1907	101	35,354,087	4,297,725	9,730,805	19,279,392	...	2,046,165
	1902	96	19,552,955	3,428,461	10,333,127	5,719,589	...	71,778
New Jersey	1912	24	7,232,887	1,254,842	2,732,775	3,229,045	...	16,225
	1907	24	5,755,396	627,510	2,840,704	2,272,148	...	15,034
	1902	25	3,625,740	431,912	1,573,411	1,586,217	...	34,200
Pennsylvania	1912	121	24,885,197	2,258,831	6,407,935	13,995,098	1,096,069	1,127,264
	1907	122	19,344,023	1,224,394	4,319,749	13,554,786	...	245,094
	1902	98	12,868,286	1,576,476	2,056,166	8,902,431	...	333,213

[1] Included with "Miscellaneous" in 1907 and 1902.

STREET AND ELECTRIC RAILWAYS—OPERATING COMPANIES—DEDUCTIONS FROM INCOME, BY ACCOUNTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902—Continued.

Table 112—Continued. DIVISION AND STATE.	Census.	Number of companies.	Total.	Taxes.	Interest.	Rent of leased lines and terminals.	Charges for sinking fund.[1]	Miscellaneous.
EAST NORTH CENTRAL:								
Ohio	1912	75	$11,635,394	$2,525,422	$5,429,129	$3,390,165	$98,120	$192,558
	1907	73	9,215,583	1,387,052	4,612,432	3,155,380	...	60,719
	1902	62	4,137,866	601,142	2,457,584	1,066,636	...	12,504
Indiana	1912	34	5,727,969	536,210	3,217,272	1,744,017	170,520	59,950
	1907	33	4,477,535	499,273	1,883,272	1,966,943	...	128,047
	1902	26	1,201,297	185,014	984,391	...	...	31,892
Illinois	1912	67	20,903,293	4,885,069	12,182,594	494,136	1,263,086	2,078,408
	1907	70	10,668,510	2,018,189	5,907,635	2,648,012	...	94,674
	1902	48	8,453,191	1,488,359	3,037,830	3,875,007	...	51,995
Michigan	1912	22	4,642,698	760,270	2,419,622	583,550	514,935	364,321
	1907	24	2,867,083	386,514	2,445,809	...	...	34,760
	1902	24	1,788,797	228,538	1,547,772	...	...	12,487
Wisconsin	1912	24	2,984,632	504,665	1,751,527	7,500	52,920	668,020
	1907	20	2,180,929	325,966	1,380,206	...	...	474,757
	1902	17	1,081,160	150,059	646,194	...	...	284,907
WEST NORTH CENTRAL:								
Minnesota	1912	9	1,890,203	612,291	1,178,750	3,000	1,250	94,912
	1907	5	2,128,156	415,965	1,122,138	...	...	590,053
	1902	5	1,027,121	131,128	870,038	24,064	...	1,891
Iowa	1912	24	1,478,449	209,664	1,053,700	3,840	66,973	144,272
	1907	24	894,434	99,582	749,454	2,913	...	42,485
	1902	22	429,373	54,115	353,118	...	...	22,140
Missouri	1912	19	5,903,974	1,249,643	4,568,005	14,148	55,000	17,178
	1907	14	6,150,063	1,098,222	4,490,780	14,400	...	546,661
	1902	16	4,635,401	646,682	1,756,840	2,230,164	...	1,715
North and South Dakota	1912	5	40,865	7,375	30,805	...	...	2,685
	1907	5	19,993	2,069	17,761	...	...	163
Nebraska	1912	7	1,037,505	265,235	613,977	156,960	...	1,333
	1907	8	895,573	139,398	390,017	97,840	...	268,318
	1902	4	150,297	28,252	122,045	...	...	...
Kansas	1912	21	874,495	145,837	657,408	...	...	71,250
	1907	17	305,888	33,822	263,148	346	...	8,572
	1902	11	64,451	8,401	56,050	...	...	...
SOUTH ATLANTIC:								
Delaware, Maryland, and District of Columbia	1912	25	6,031,007	1,165,421	3,957,157	647,264	72,131	189,034
	1907	23	3,911,923	793,877	3,057,630	48,700	...	11,716
	1902	21	3,314,632	576,658	2,734,999	1,975	...	1,000
Virginia	1912	18	2,434,012	384,277	1,509,103	360,944	16,561	163,127
	1907	22	1,287,931	240,169	756,190	239,375	...	52,197
	1902	16	547,730	46,845	490,484	...	...	10,401
West Virginia	1912	21	994,778	162,645	799,766	26,801	5,000	566
	1907	15	743,200	93,493	639,756	4,795	...	5,156
	1902	8	265,842	28,030	237,812	...	...	...
North Carolina	1912	13	534,904	59,479	348,740	56,678	...	70,007
	1907	11	353,806	39,058	220,922	52,500	...	41,326
	1902	7	98,993	10,791	87,219	...	...	983
South Carolina	1912	6	300,118	36,895	97,820	161,443	3,960	...
	1907	7	390,713	42,007	340,706	...	...	8,000
	1902	7	203,196	21,109	180,392	720	...	975
Georgia	1912	14	2,557,659	447,764	827,888	1,142,200	25,000	114,807
	1907	12	1,124,989	290,235	830,757	...	...	3,997
	1902	10	755,207	110,846	644,361	...	...	...
Florida	1912	10	424,717	97,517	285,815	...	38,680	2,705
	1907	10	186,222	49,585	136,637	...	...	...
	1902	6	74,779	12,439	62,340	...	...	...
EAST SOUTH CENTRAL:								
Kentucky	1912	10	1,315,752	376,922	924,293	10,462	2,900	1,175
	1907	13	1,109,233	313,328	789,097	...	...	6,808
	1902	12	777,433	177,775	598,594	...	...	1,064
Tennessee	1912	12	1,919,301	419,175	1,418,102	...	...	82,024
	1907	9	1,418,575	310,140	1,040,975	...	...	67,460
	1902	8	595,356	113,573	478,473	...	...	3,310
Alabama	1912	11	1,195,680	276,354	8 2,634	1,236	81,013	4,443
	1907	10	988,048	178,373	741,292	...	...	68,383
	1902	9	384,762	37,047	347,330	...	...	385
Mississippi	1912	12	296,833	33,302	263,531	...	...	...
	1907	8	247,833	31,890	209,121	...	...	6,822
	1902	5	38,684	4,501	34,183	...	...	...

[1] Included with "Miscellaneous" in 1907 and 1902.

STREET AND ELECTRIC RAILWAYS—OPERATING COMPANIES—DEDUCTIONS FROM INCOME, BY ACCOUNTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902—Continued.

Table 112—Continued.

DIVISION AND STATE.	Census.	Number of companies.	Total.	Taxes.	Interest.	Rent of leased lines and terminals.	Charges for sinking fund.[1]	Miscellaneous.
WEST SOUTH CENTRAL:								
Arkansas	1912	10	$474,638	$91,649	$374,635	...	...	$8,354
	1907	8	263,537	30,817	232,720	...	...	...
	1902	7	68,071	7,213	60,858	...	...	...
Louisiana	1912	13	2,295,075	408,323	1,271,989	$538,820	$12,000	63,943
	1907	11	1,890,680	359,837	1,173,857	320,449	...	36,537
	1902	8	690,380	200,156	483,594	...	...	6,630
Oklahoma	1912	17	498,584	64,924	398,691	12,719	6,250	16,000
	1907	8	109,230	7,732	86,645	...	...	14,853
Texas	1912	39	1,871,243	318,551	1,369,589	128	179,749	3,226
	1907	23	932,282	146,669	785,613	...	...	...
	1902	17	199,483	36,919	162,564	...	...	...
MOUNTAIN:								
Montana	1912	6	224,729	44,387	116,650	...	12,490	51,202
	1907	5	120,851	22,519	79,638	...	...	18,694
	1902	5	74,633	13,975	60,658	...	...	...
Colorado	1912	16	2,106,967	377,718	1,552,279	69,955	54,463	52,552
	1907	11	1,273,024	148,462	1,033,840	...	...	90,722
	1902	7	536,005	78,264	454,479	3,262	...	...
All other Mountain states	1912	18	1,397,370	167,755	799,607	109,357	320,413	238
Idaho, Wyoming, Nevada, and Utah	1912	12	1,302,819	156,302	716,509	109,357	320,413	238
New Mexico and Arizona	1912	6	94,551	11,453	83,098	...	...	...
All other Mountain states	1907	12	517,452	67,323	450,129	...	...	...
	1902	6	176,723	17,523	159,091	...	...	109
PACIFIC:								
Washington	1912	19	4,033,973	858,974	2,846,702	141,073	174,643	12,581
	1907	14	1,788,314	388,322	1,281,023	117,417	...	1,552
	1902	8	463,101	78,239	384,862	...	...	...
Oregon	1912	6	3,050,248	560,380	2,127,132	...	...	362,736
	1907	8	992,748	117,548	875,200	...	...	...
	1902	6	146,519	17,622	128,897	...	...	...
California	1912	35	10,696,969	1,487,425	7,480,561	255,416	1,122,285	351,282
	1907	41	6,732,705	896,273	5,189,609	215,831	...	430,992
	1902	35	2,112,959	495,179	1,617,550	...	...	230

[1] Included with "Miscellaneous" in 1907 and 1902.

In all states, with one exception (South Carolina), there is shown an increase in taxes for 1912 over 1907, and in 1907 only one state (Pennsylvania) showed a decrease with respect to 1902, occasioned by a difference in division of the taxes between operating and lessor companies at the two censuses.

Table 113 shows, for geographic divisions and states, the taxes reported in 1912, by class.

The payment of taxes on real and personal property was reported for all states, taxes on capital stock for 33 states, taxes on earnings for 40 states, and miscellaneous taxes for 41 states. In 1907, 26 states, and in 1902, 14 states, imposed a tax on capital stock and bonds. Taxes on earnings were levied in 33 states in 1907 and in 23 in 1902. The East North Central states reported the largest amounts for real and personal property tax and tax on earnings, the New England states the largest amount for tax on capital stock, and the Middle Atlantic states the largest amounts for Federal corporation and miscellaneous taxes.

STREET AND ELECTRIC RAILWAYS—TAXES: 1912.

Table 113

DIVISION AND STATE.	Total.	On real and personal property.	On capital stock.	On earnings.	Federal corporation tax.	Miscellaneous.
UNITED STATES	$35,027,965	$15,658,239	$3,899,146	$9,486,792	$1,016,901	$4,966,887
GEOGRAPHIC DIVISIONS:						
New England	4,237,429	1,006,464	1,658,536	827,761	95,169	649,499
Middle Atlantic	11,249,018	2,985,787	1,503,794	3,028,532	424,187	3,306,718
East North Central	9,211,636	4,864,084	424,154	3,385,171	211,730	326,497
West North Central	2,490,045	2,093,401	26,715	243,264	82,924	43,741
South Atlantic	2,353,998	1,049,168	63,789	1,036,975	72,285	131,781
East South Central	1,105,753	750,054	201,313	11,395	25,008	117,983
West South Central	883,447	506,683	2,995	136,926	20,750	216,093
Mountain	589,860	482,068	951	13,440	20,112	73,289
Pacific	2,906,779	1,920,530	16,899	803,328	64,736	101,286
NEW ENGLAND:						
Maine	120,208	100,731	46	11,893	3,985	3,553
New Hampshire	39,912	39,461			451	
Vermont	19,596	11,000	2,029	6,282	206	79
Massachusetts	3,108,197	689,910	1,131,952	571,615	71,656	643,064
Rhode Island and Connecticut	949,516	165,362	524,509	237,971	18,871	2,803
MIDDLE ATLANTIC:						
New York	7,735,345	2,370,041	273,363	1,785,353	250,153	3,056,435
New Jersey	1,254,842	489,941	2,022	693,000	28,087	41,792
Pennsylvania	2,258,831	125,805	1,228,409	550,179	145,947	208,491
EAST NORTH CENTRAL:						
Ohio	2,525,422	1,534,991	91,561	743,907	62,515	92,448
Indiana	536,210	471,517		708	18,290	45,695
Illinois	4,885,069	1,715,491	332,593	2,555,556	101,125	180,304
Michigan	760,270	650,771		85,000	19,220	5,279
Wisconsin	504,665	491,314			10,580	2,771
WEST NORTH CENTRAL:						
Minnesota	612,291	528,181	21,270	20,141	28,712	13,987
Iowa	209,664	192,151	2,024	4,626	9,326	1,537
Missouri	1,249,643	1,030,044	1,791	161,066	35,901	20,841
North and South Dakota	7,375	7,264			111	
Nebraska	265,235	201,044	1,060	57,296	5,835	
Kansas	145,837	134,717	570	135	3,039	7,376
SOUTH ATLANTIC:						
Delaware, Maryland, and District of Columbia	1,165,421	244,203	56,568	747,784	27,824	89,042
Virginia	384,277	196,149	3,593	169,861	11,418	3,256
West Virginia	162,645	141,557	1,053	11,144	5,716	3,175
North Carolina	59,479	51,891	740	3,936	1,750	1,162
South Carolina	36,895	21,596		2,626	1,456	11,217
Georgia	447,764	324,396	150	82,810	20,527	19,881
Florida	97,517	69,376	1,685	18,814	3,594	4,048
EAST SOUTH CENTRAL:						
Kentucky	376,922	120,694	195,216	6,608	9,789	44,615
Tennessee	419,175	360,667	179	477	6,267	51,585
Alabama	276,354	237,430	5,918	4,310	8,333	20,363
Mississippi	33,302	31,263			619	1,420
WEST SOUTH CENTRAL:						
Arkansas	91,649	70,979	1,836	11,801	3,430	3,603
Louisiana	408,323	171,103	199	63,111	6,877	167,033
Oklahoma	64,924	63,848		422	438	216
Texas	318,551	200,753	960	61,592	10,005	45,241
MOUNTAIN:						
Montana	44,387	37,892		5,745		750
Colorado	377,718	290,014	374	6,067	12,382	68,881
All other Mountain states	167,755	154,162	577	1,628	7,730	3,658
PACFIC:						
Washington	858,974	727,509	11,708	84,567	29,520	5,670
Oregon	560,380	557,001	525	1,529		1,325
California	1,487,425	636,020	4,666	717,232	35,216	94,291

The per cent distribution of taxes, by kind, in 1912 is given in Table 114, for the geographic divisions.

Table 114

DIVISION.	PER CENT DISTRIBUTION OF TAXES: 1912 (BASED ON TABLE 113).					
	Total.	On real and personal property.	On capital stock.	On earnings.	Federal corporation tax.	Miscellaneous.
United States	100.0	44.7	11.1	27.1	2.9	14.2
New England	100.0	23.8	39.1	19.5	2.2	15.3
Middle Atlantic	100.0	26.5	13.4	26.9	3.8	29.4
East North Central	100.0	52.8	4.6	36.7	2.3	3.5
West North Central	100.0	84.1	1.1	9.8	3.3	1.8
South Atlantic	100.0	44.6	2.7	44.1	3.1	5.6
East South Central	100.0	67.8	18.2	1.0	2.3	10.7
West South Central	100.0	57.4	0.3	15.5	2.4	24.5
Mountain	100.0	81.7	0.1	2.3	3.5	12.4
Pacific	100.0	66.1	0.6	27.5	2.2	3.5

In the New England and Middle Atlantic divisions taxes on real and personal property constituted but one-fourth, approximately, of the total taxes, taxes on capital stock being the largest factor for New England as a whole, while miscellaneous taxes formed the greatest item for the Middle Atlantic division, principally on account of the special franchise taxes of the New York City lines.

In the South Atlantic division the tax on earnings is but a little less in the aggregate than the tax on real and personal property, this being due to conditions in Maryland and the District of Columbia; and in the East North Central division tax on earnings constitutes a little more than a third of the total taxes, on account of conditions in Ohio and Illinois. Of the $2,555,556 reported as tax on earnings for Illinois, $2,529,992 is the share of net receipts (55 per cent) paid the city of Chicago by the Chicago City Railway Co. and the Chicago Railways Co. The large ratio for the Pacific division is due to conditions in California, in which state the tax on earnings formed 48.2 per cent of all taxes.

Interest.—The annual payments by street and electric railways to meet interest charges on their funded and floating debt and real-estate mortgages amounted to $98,025,338 in 1912, an increase of 53.8 per cent over 1907. Earlier tables accompanying the discussion of income account show, for companies as a whole and by groups, the interest charges of operating and lessor companies in their relation to gross income, and in Chapter VI there appears an analysis of the statistics relating to interest on funded and floating debt and mortgages. The following statement shows the interest paid by operating and lessor companies:

CLASS OF COMPANY.	INTEREST.		
	1912	1907	1902
Total—All companies	$113,259,470	$81,771,266	$46,462,470
Operating companies	98,025,338	63,740,744	38,085,911
Lessor companies	15,234,132	18,030,522	8,376,559

Although the interest on bonds of leased companies is guaranteed by the lessor companies, and often paid directly by the latter to their bondholders, the distinction between the two classes of securities with respect to the interest accruing thereon is preserved in the census statistics. By dividing the total interest by the aggregate funded and floating debt and real-estate mortgages, there is given an average rate of 4.3 per cent for 1912, as compared with 4.2 per cent for 1907.

Rent of leased lines and terminals.—Payments by operating companies for the use of track owned by nonoperating lessor companies form the greater part of this item, but it also includes a considerable amount paid by operating companies for the use of track leased from other operating companies and track leased from steam roads, as well as rentals paid municipalities for subways and bridge trackage. It does not include, however, track rentals in cases where the owning companies also operate over the tracks. Such use is classed as a trackage right, and the rental is considered an operating expense, and in accordance with the standard system of accounting is charged to "Rent of tracks and terminals" in the group of "General and miscellaneous" accounts of operating expenses. It should be explained that subway rentals paid the municipalities of New York and Boston, reported in 1912 under "Rent of leased lines and terminals," were classed in 1907 under "Miscellaneous deductions" from income. They aggregated in 1907, $1,996,821. The transfer of this amount to rent of leased lines and terminals for 1907, though not affecting deductions from income as a whole, gives a total of $50,019,417 for rent of leased lines and terminals for that year, as compared with $44,784,521 in 1912.

The total amount paid by operating companies for the rent of leased lines and terminals in 1912 shows a decrease of 6.7 per cent from the amount reported in 1907, or of 10.5 per cent with the above change in classification. Next to interest this item constituted the largest fixed charge. By reference to Table 112 it will be seen that although rentals for leased lines were paid in 1912 in 33 states, $29,908,785, or 67 per cent of the total, was reported for the Middle Atlantic division, as compared with $35,106,326, or 73 per cent, in 1907, and that the reduction in rentals in 1912, as compared with 1907, is due to changes in conditions in New York and Illinois, and in a slight degree in Indiana.

Charges for sinking fund and miscellaneous deductions.—Charges for sinking fund to the amount of $6,229,136 were reported in 1912. In 1907 and 1902 they were included under "Miscellaneous deductions" from income and not reported separately. In reporting these minor accounts the practice of the companies lacks uniformity. In general, it appears that depreciation, when accounted for as a deduction from income and not as a charge to maintenance, is included under "Sinking funds," but the returns do not permit a statistical presentation of depreciation accounts. Some of the items reported under "Miscellaneous deductions" in 1912 are amortization of debt, discount, and expense; miscellaneous rents; taxes in litigation; and deductions from income from outside sources. For comparative purposes it is necessary to combine sinking-fund charges and miscellaneous deductions. They aggregated $13,285,584 in 1912, as compared with $6,575,774 in 1907, an increase of 102 per cent. If the subway rentals included under "Miscellaneous deductions" in 1907, above cited, are transferred to rent of leased lines, the increase is somewhat larger. Of the total of $6,575,774 reported under the heading of "Miscellaneous deductions" in 1907, $2,397,250 represented charges for depreciation, specifically reported as such, or credits to depreciation and sinking funds.

Deductions from income for groups of companies.—Table 115 presents the deductions from income for companies classified according to income from railway operations, at the censuses of 1912, 1907, and 1902; Table 116, percentages showing distribution of totals and accounts, based upon Table 115; and Table 117, statistics similar to those in Table 115, for companies classified as "Elevated and subway" and "Surface" in 1912.

Table 115 DEDUCTIONS FROM INCOME, BY ACCOUNTS, FOR COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS: CLASS A, $1,000 000 AND OVER; CLASS B, $250,000 BUT LESS THAN $1,000,000; CLASS C, LESS THAN $250,000.

ACCOUNTS, BY CLASS.	1912	1907	1902	Per cent of increase.[1]		
				1902-1912	1907-1912	1902-1907
Number of companies	975	939	799	22.0	3.8	17.5
Class A	91	76	44	106.8	19.7	72.7
Class B	155	130	81	91.4	19.2	60.5
Class C	729	733	674	8.2	0.5	8.8
Deductions from income	$191,123,408	$138,094,716	$77,595,053	146.3	38.4	78.0
Class A	148,640,699	102,004,702	56,819,948	161.6	45.7	79.5
Class B	25,425,531	20,911,111	10,936,393	132.5	21.6	91.2
Class C	17,057,178	15,178,903	9,838,712	73.4	12.4	54.3
Taxes	35,027,965	19,755,602	13,078,899	167.8	77.3	51.0
Class A	28,702,175	15,524,362	10,326,341	178.0	84.8	50.3
Class B	3,935,021	2,479,106	1,499,191	162.5	58.7	65.4
Class C	2,390,769	1,752,134	1,253,367	90.7	36.5	39.8
Interest on funded floating debt and and mortgages	98,025,338	63,740,744	38,085,911	157.4	53.8	67.4
Class A	68,147,448	35,648,870	21,796,528	212.7	91.2	63.6
Class B	16,712,732	15,502,292	8,219,411	103.3	10.8	88.6
Class C	13,165,158	12,589,582	8,069,972	63.1	4.6	56.0
Rent of leased lines and terminals	44,784,521	48,022,596	25,518,225	75.5	−6.7	88.2
Class A	41,334,414	45,188,356	24,296,050	70.1	−8.5	86.0
Class B	2,945,111	2,302,537	922,925	219.1	27.9	149.5
Class C	504,996	531,703	299,250	68.8	5.0	77.7
Charges for sinking fund	6,229,136	(2)	(2)	......	......	......
Class A	5,413,063	......	......	......	......	......
Class B	594,446	......	......	......	......	......
Class C	221,627	......	......	......	......	......
Miscellaneous deductions	7,056,448	6,575,774	912,018	673.7	7.3	621.0
Class A	5,043,599	5,643,114	401,029	1157.7	−10.6	1307.2
Class B	1,238,221	627,176	294,866	319.9	97.4	112.7
Class C	774,628	305,484	216,123	258.4	153.6	41.4

[1] A minus sign (−) denotes decrease.

[2] Figures not available.

Table 116 PER CENT DISTRIBUTION OF DEDUCTIONS FROM INCOME, BY ACCOUNTS, FOR COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS (BASED ON TABLE 115).

ACCOUNTS, BY CLASS.	Per cent of total.			Per cent of total deductions from income.		
	1912	1907	1902	1912	1907	1902
Number of companies	100.0	100.0	100.0	......	......	......
Class A	9.3	8.1	5.5	......	......	......
Class B	15.9	13.8	10.1	......	......	......
Class C	74.8	78.1	84.4	......	......	......
Deductions from income	100.0	100.0	100.0	100.0	100.0	100.0
Class A	77.8	73.9	73.2	100.0	100.0	100.0
Class B	13.3	15.1	14.1	100.0	100.0	100.0
Class C	8.9	11.0	12.7	100.0	100.0	100.0
Taxes	100.0	100.0	100.0	18.3	14.3	16.9
Class A	81.9	78.6	79.0	19.3	15.2	18.2
Class B	11.2	12.5	11.5	15.5	11.9	13.7
Class C	6.8	8.9	9.6	14.0	11.5	12.7
Interest on funded and floating debt and mortgages	100.0	100.0	100.0	51.3	46.2	49.1
Class A	69.5	55.9	57.2	45.8	34.9	38.4
Class B	17.0	24.3	21.6	65.7	74.1	75.2
Class C	13.4	19.8	21.2	77.2	82.9	82.0
Rent of leased lines and terminals	100.0	100.0	100.0	23.4	34.8	32.9
Class A	92.3	94.1	95.2	27.8	44.3	42.8
Class B	6.6	4.8	3.6	11.6	11.0	8.4
Class C	1.1	1.1	1.2	2.9	3.5	3.0
Charges for sinking fund	100.0	......	......	3.3	......	......
Class A	86.9	......	......	3.6	......	......
Class B	9.5	......	......	2.3	......	......
Class C	3.6	......	......	1.3	......	......
Miscellaneous deductions	100.0	100.0	100.0	3.7	4.8	1.2
Class A	71.5	85.9	44.0	3.4	5.5	0.7
Class B	17.5	9.5	32.3	4.9	3.0	2.7
Class C	11.0	4.6	23.7	4.5	2.0	2.2

Table 117 DEDUCTIONS FROM INCOME, BY ACCOUNTS, FOR COMPANIES CLASSIFIED AS "ELEVATED AND SUBWAY" AND "SURFACE:" 1912.

ACCOUNT.	Total.	Elevated and subway.	Surface.	Per cent of deductions from income.	
				Elevated and subway.	Surface.
Number of companies	975	7	968	......	......
Deductions from income	$191,123,408	$22,732,065	$168,391,343	100.0	100.0
Taxes	35,027,965	3,500,657	31,527,308	15.4	18.7
Interest on funded and floating debt and mortgages	98,025,338	9,654,473	88,370,865	42.5	52.5
Rent of leased lines and terminals	44,784,521	8,795,655	35,988,866	38.7	21.4
Charges for sinking fund	6,229,136	329,692	5,899,444	1.5	3.5
Miscellaneous deductions	7,056,448	451,588	6,604,860	2.0	3.9

GENERAL RESULTS OF OPERATION.

The standards or units employed for gauging operative results are the mile of track, the car-mile, and revenue passenger. The averages obtained by applying these standards to the operating revenues, operating expenses, and operating or net earnings for all classes of companies operating under varying conditions furnish a much better measure of the general trend of operative conditions than is provided by large aggregates alone. A mile of track, as a unit of measure, expresses the foundation upon which all railway business rests and is perhaps the best unit of comparison for all general statistics. The car-mile unit is employed by all street and electric railway companies, and though the car-hour has certain advantages over the car-mile, it is not in general use. The revenue-passenger unit is used by all roads doing a passenger business. It must be borne in mind that the car-mile unit is complex and involves capacity as well as distance. Hence the unit is not fixed, since, while the distance factor is constant, the capacity of a car is varying. Indeed, the variation of this factor is one of the changes that car-mile statistics are designed to show. Capacity depends upon the size and type of car and to a certain extent upon speed.

Similarly, the revenue-passenger unit is influenced in a number of ways. A change in the policy of a railway in granting free transfers may mean a change in the number of revenue passengers carried without a change in other traffic statistics. Again, the revenue-passenger unit assumes a uniform average length of ride for all companies. This assumption is only roughly true for strictly urban traffic, while the development of suburban and interurban lines has introduced a large and growing number of long-trip passengers, and in some cases long-trip passengers pay their fare by "zones" and in some cases by the trip. Where the zone system is used, the passenger as a unit is not far different from the passenger of the urban statistics, though undoubtedly representing a distance traveled above the average for urban passengers, but to the extent that interurban passengers are counted by the trip the resultant averages are increased beyond what they would be if based solely upon urban traffic.

Table 118 presents certain operating averages per mile of track, per car-mile, and per revenue passenger for all companies and for companies classified according to income from railway operations, for 1912, 1907, and 1902.

Table 118

UNIT.	GENERAL RESULTS OF OPERATIONS OF ALL COMPANIES AND OF COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS.											
	Total—All companies.			Class A. $1,000,000 or over.			Class B. $250,000 but less than $1,000,000.			Class C. Less than $250,000.		
	1912	**1907**	**1902**	**1912**	**1907**	**1902**	**1912**	**1907**	**1902**	**1912**	**1907**	**1902**
Number of companies	975	939	799	91	76	44	155	130	81	729	733	674
Ratio of operating expenses to operating revenues (per cent)	58.7	60.1	57.5	56.7	58.4	54.8	61.7	61.9	58.8	68.3	67.4	67.7
Per mile of track:												
Operating revenues	$13,820	$12,268	$11,154	$19,844	$19,287	$19,946	$8,937	$8,009	$8,265	$5,784	$5,251	$4,464
Operating revenues exclusive of income from sale of current	12,931	11,678	10,807	19,011	18,798	19,691	7,929	7,415	7,907	4,890	4,516	4,037
Operating expenses	8,107	7,373	6,412	11,252	11,256	10,921	5,517	4,956	4,857	3,949	3,539	3,021
Net operating revenue	5,713	4,895	4,742	8,592	8,032	9,025	3,420	3,053	3,408	1,835	1,712	1,443
Per car-mile:	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Operating revenues	29.53	25.97	21.87	29.49	26.25	22.92	30.63	25.71	21.21	28.32	24.84	18.85
Operating revenues exclusive of income from sale of current	27.63	24.72	21.19	28.25	25.58	22.63	27.18	23.80	20.29	23.94	21.36	17.04
Operating expenses	17.32	15.61	12.57	16.72	15.32	12.55	18.91	15.91	12.46	19.33	16.74	12.75
Conducting transportation	9.87	8.76	7.43	9.62	8.84	7.62	10.56	9.01	7.31	10.71	9.47	7.56
All other	7.45	6.84	5.15	7.10	6.48	4.93	8.35	6.90	5.15	8.62	7.27	5.19
Net operating revenue	12.21	10.36	9.30	12.77	10.93	10.37	11.72	9.80	8.75	8.99	8.10	6.10
Per revenue passenger:												
Operating revenues	5.95	5.63	5.23	5.54	5.28	5.00	7.51	6.53	5.57	7.68	6.99	6.08
Passenger revenue	5.27	5.15	4.94	5.08	4.99	4.84	6.10	5.69	5.16	5.87	5.61	5.24
All other	0.68	0.49	0.29	0.46	0.30	0.16	1.41	0.84	0.42	1.80	1.38	0.84
Operating expenses	3.49	3.39	3.01	3.14	3.08	2.74	4.64	4.04	3.28	5.24	4.71	4.11
Net operating revenue	2.46	2.25	2.23	2.40	2.20	2.26	2.87	2.49	2.30	2.44	2.28	1.96

A disturbing factor in all comparisons based upon total income or total expenses is the inclusion of income and expenses incident to the operation of electric light and power plants in conjunction with railways. If the proportions for the income and expenses incident to light and power business with respect to total income and expense remained the same, the averages for the different years would be on an equal footing, and hence would indicate the changes. But this is not the case, for the income from the sale of current formed 6.4 per cent of the total operating revenues reported for 1912, as compared with 4.8 per cent in 1907 and 3.1 per cent in 1902. Though these percentages are small, the amounts involved are large, and their exclusion perceptibly affects the averages. Thus the exclusion of income from sale of current results in reducing the revenue per mile of track by $889 in 1912, as compared with $590 in 1907 and $347 in 1902; and the revenue per car-mile by 1.9 cents in 1912, as compared with 1.25 cents in 1907 and seven-tenths of a cent in 1902.

Table 119 presents similar averages for companies classified as without and with commercial lighting and for companies classified as "Elevated and subway" and "Surface."

Table 119

UNIT.	GENERAL RESULTS OF OPERATIONS.									
	Companies without and with commercial lighting.						Companies classified as "Elevated and subway" and "Surface."			
	Without commercial lighting.			With commercial lighting.			Elevated and subway.		Surface.	
	1912	**1907**	**1902**	**1912**	**1907**	**1902**	**1912**	**1907**	**1912**	**1907**
Number of companies	760	709	630	169	175	112	7	6	922	933
Ratio of operating expenses to operating revenues (per cent)	59.2	60.0	57.4	56.0	60.3	58.1	44.1	44.7	59.9	61.5
Per mile of track:										
Operating revenues	$14,487	$13,178	$11,794	$11,840	$10,022	$8,978	$100,884	$80,727	$12,708	$11,414
Operating expenses	8,582	7,910	6,772	6,632	6,039	5,217	45,601	36,054	7,628	7,014
Net operating revenue	5,905	5,268	5,022	5,208	3,983	3,761	55,283	44,673	5,080	4,400
Per car-mile:	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Operating revenues	28.05	25.19	21.57	38.47	30.85	25.97	23.80	23.58	30.27	26.20
Operating expenses	16.62	15.12	12.39	21.55	18.59	15.09	10.76	10.53	18.17	16.10
Conducting transportation	9.60	(1)	(1)	11.51	(1)	(1)	6.62	(1)	10.29	(1)
All other	7.02	(1)	(1)	10.04	(1)	(1)	4.14	(1)	7.88	(1)
Net operating revenue	11.43	10.07	9.18	16.92	12.26	10.88	13.04	13.05	12.10	10.10
Per revenue passenger:										
Operating revenues	5.54	5.36	5.08	8.76	7.56	7.22	5.27	5.33	6.02	5.66
Passenger revenue	5.21	5.10	4.93	5.64	5.42	4.93	5.08	4.97	5.28	5.17
All other	0.33	0.25	0.15	3.12	2.13	2.29	0.19	0.36	0.74	0.50
Operating expenses	3.28	3.21	2.92	4.90	4.55	4.20	2.38	2.38	3.62	3.48
Net operating revenue	2.26	2.14	2.16	3.85	3.00	3.03	2.89	2.95	2.41	2.18

[1] Figures not available.

Earnings per mile of track.—The averages based on totals which exclude earnings from the sale of current are undoubtedly the correct ones by which to gauge railway operations. On this basis the operating earnings per mile of track show a substantial increase for 1912 over 1907 and for 1907 over 1902.

Table 120 shows the increases and decreases, for the census periods 1907–1912 and 1902–1907, in operating revenues, expenses, and net revenues per mile of track for all companies and for classes A, B, and C.

Table 120	OPERATING REVENUES, OPERATING EXPENSES, AND NET REVENUE PER MILE OF TRACK.				
CLASS AND ACCOUNT.	1912	1907	1902	1902–1912	
				Increase.	Decrease.
Total—All companies:					
Operating revenues	$13,820	$12,268	$11,154	$2,666	....
Operating revenues exclusive of income from sale of current	12,931	11,678	10,807	2,124	....
Operating expenses	8,107	7,373	6,412	1,695	....
Net operating revenue	5,713	4,895	4,742	971	....
Classified according to income from railway operations:					
Class A—					
Operating revenues	19,844	19,287	19,946	....	$102
Operating revenues exclusive of income from sale of current	19,011	18,798	19,691	....	680
Operating expenses	11,252	11,256	10,921	331	....
Net operating revenue	8,592	8,032	9,025	....	433
Class B—					
Operating revenues	8,937	8,009	8,265	672	....
Operating revenues exclusive of income from sale of current	7,929	7,415	7,907	22	....
Operating expenses	5,517	4,956	4,857	660	....
Net operating revenue	3,420	3,053	3,408	12	....
Class C—					
Operating revenues	5,784	5,251	4,464	1,320	....
Operating revenues exclusive of income from sale of current	4,890	4,516	4,037	853	....
Operating expenses	3,949	3,539	3,021	928	....
Net operating revenue	1,835	1,712	1,443	392	....

The decrease for the decade in revenue per mile of track shown for class A is accounted for by the fact that the proportionate increase in miles of track is greater than that in earnings exclusive of receipts from sale of current.

The averages for classes A and B are affected by the inclusion in class A of six and in class B of one of the seven elevated and subway companies (1912) whose average earnings are shown in Table 119. Since the earnings and expenses per mile of track for these companies are large, they necessarily increase materially the averages for the two classes named, and particularly those for class A.

Freight and express business forms a growing department of activity for street and electric railways, and this service has added to operating earnings; and although the ratio between expenses incident to freight and express traffic and the income derived therefrom can not be determined, it should be remembered in considering averages.

Table 121 shows the freight and express revenues per mile of track, by groups of companies.

There were 540 companies in 1912, or 55.4 per cent of the total number, that reported earnings from freight, baggage, express, or milk business, as compared with 454, or 48 per cent of the total, in 1907, and 265, or 32.4 per cent, in 1902. It was impracticable, however, to ascertain the number of miles of track over which freight or express matter was carried, and therefore the total trackage has been used in all cases as the divisor in computing the average earnings from this business.

Table 121	FREIGHT AND EXPRESS REVENUES PER MILE OF TRACK.					
	1912	1907	1902	Increase.		
				1902–1912	1907–1912	1902–1907
All companies	$337	$199	$65	$272	$138	$134
Class A	320	159	37	283	161	122
Class B	424	282	81	343	142	201
Class C	291	192	83	208	99	109
Elevated and subway	80	75	(1)	....	5	....
Surface	341	201	(1)	....	140	....

[1] Figures not available.

Table 122 shows the number of companies doing freight, mail, express, etc., business, by geographic divisions, in 1912.

Table 122		NUMBER OF COMPANIES DOING FREIGHT, MAIL, EXPRESS, ETC., BUSINESS: 1912.					
		Number of companies reporting—				Per cent of total number.	
DIVISION.	Total number of companies.	Either freight, baggage, express, or milk revenue.	Freight revenue.	Baggage, express, or milk revenue.	Mail revenue.	Either freight, baggage, express, or milk revenue.	Mail revenue.
United States	975	540	406	382	371	55.4	38.0
New England	91	62	43	38	59	68.1	64.8
Middle Atlantic	246	148	102	100	93	60.1	37.8
East North Central	222	141	114	122	90	63.5	40.5
West North Central	85	43	31	31	31	50.6	36.4
South Atlantic	107	52	41	33	37	48.6	34.6
East South Central	45	17	14	7	14	37.8	31.1
West South Central	79	19	11	11	12	24.1	15.2
Mountain	40	19	16	12	8	47.5	20.0
Pacific	60	39	34	28	27	65.0	35.0

In the New England division the largest proportion of the companies reported revenue from either freight, baggage, express, or milk business, namely, 68.1 per cent, while the West South Central division shows the lowest proportion, 24.1 per cent. With respect to the carrying of mails, 371 companies, or 38 per cent of the total number, reported mail revenue in 1912, the highest proportion showing for the New England division, 64.8 per cent, and the lowest for the West South Central, 15.2 per cent.

Income from railway operations in state.—The operating revenues credited to the states, as given in Table 161 (p. 308), as well as all general state financial statistics, are based upon the returns of the companies credited to the respective states; but, as elsewhere explained, in some cases the statistics for a state include those pertaining to traffic outside of the state, while in other cases they exclude data for traffic within the state reported by a company of an adjoining state. It is possible to determine with approximate accuracy the income from railway operations chargeable to the trackage operated within a state by distributing for each interstate company the income from railway operations on a mile-of-track basis and assigning to each state a share of the income from railway operations corresponding to the proportion of its total trackage operated by the company in that state. There is thus secured a figure for the income from railway operations within the confines of a state commensurate with the miles of track operated therein, whether by companies within or without the state, and, as a result, the average income from railway operations per mile of track for the actual trackage of each state. Table 123 shows these statistics by states: First, the miles of track operated by the companies located in the respective states, the income from railway operations, and the average per mile of track; and, second, the miles of track operated within the respective states, the income from the operation thereof, and the average income per mile of track.

STREET AND ELECTRIC RAILWAYS—MILES OF TRACK AND INCOME FROM OPERATIONS.

Table 123

STATE.	Miles of of track operated by companies in state.	INCOME FROM RAILWAY OPERATIONS OF COMPANIES LOCATED IN STATE.		Miles of track operated in state.[1]	INCOME FROM RAILWAY OPERATIONS IN STATE.	
		Amount.	Average per mile of track.		Amount.	Average per mile of track.
NEW ENGLAND:						
Maine	536.38	$2,671,870	$4,981	530.49	$2,648,810	$4,993
New Hampshire	246.26	1,231,926	5,003	268.15	1,412,609	5,268
Vermont	102.85	484,663	4,712	120.83	597,071	4,941
Massachusetts	3,010.48	35,744,786	11,873	2,950.96	35,250,375	11,945
Rhode Island	395.71	13,996,897	10,008	435.37	14,278,954	9,995
Connecticut	1,002.87			993.22		
MIDDLE ATLANTIC:						
New York	4,605.44	112,301,108	24,384	4,485.81	109,298,347	24,365
New Jersey	1,319.85	17,747,541	13,447	1,308.97	19,772,211	15,105
Pennsylvania	4,117.74	53,593,671	13,015	4,269.53	54,764,712	12,827
EAST NORTH CENTRAL:						
Ohio	4,069.12	35,120,522	8,631	3,999.22	34,830,349	8,709
Indiana	2,301.34	14,052,261	6,106	2,323.38	14,156,071	6,093
Illinois	3,125.84	51,297,589	16,411	3,185.73	51,830,711	16,270
Michigan	1,507.26	17,016,992	11,290	1,526.25	17,040,685	11,165
Wisconsin	806.13	7,119,748	8,832	849.11	7,540,125	8,880
WEST NORTH CENTRAL:						
Minnesota	555.18	9,477,206	17,071	538.48	9,212,493	17,108
Iowa	803.87	5,959,210	7,413	783.87	5,874,514	7,494
Missouri	996.00	20,393,924	20,476	959.01	19,180,241	20,000
North Dakota	26.02	234,383	4,923	19.18	196,089	4,810
South Dakota	21.59			21.59		
Nebraska	243.80	3,334,753	13,678	214.46	2,831,631	13,204
Kansas	452.16	2,595,344	5,740	493.91	3,912,446	7,921
SOUTH ATLANTIC:						
Delaware	90.37	15,775,248	15,821	99.37	15,819,760	15,701
District of Columbia	214.23			188.46		
Maryland	692.51			719.74		
Virginia	561.86	4,742,483	8,441	561.49	4,726,041	8,417
West Virginia	404.98	3,181,763	7,857	330.18	2,407,664	7,292
North Carolina	190.26	1,266,911	6,659	190.26	1,266,911	6,659
South Carolina	202.60	963,857	4,757	228.08	1,121,960	4,919
Georgia	440.63	4,490,138	10,190	417.33	4,360,277	10,448
Florida	164.84	1,391,590	8,442	164.84	1,391,590	8,442
EAST SOUTH CENTRAL:						
Kentucky	493.21	5,740,328	11,639	502.38	5,822,096	11,589
Tennessee	370.28	4,729,510	12,773	360.93	4,670,391	12,940
Alabama	306.63	3,107,694	10,135	308.80	3,124,692	10,119
Mississippi	117.14	621,596	5,306	118.57	624,130	5,264
WEST SOUTH CENTRAL:						
Arkansas	122.92	1,194,265	9,716	113.72	1,129,166	9,929
Louisiana	285.10	4,738,796	16,622	285.10	4,738,796	16,622
Oklahoma	251.56	1,302,418	5,177	251.56	1,302,418	5,177
Texas	716.65	7,694,564	10,737	721.42	7,708,820	10,686
MOUNTAIN:						
Montana	99.22	802,441	8,087	99.22	802,441	8,087
Colorado	467.97	4,617,746	9,868	467.97	4,617,746	9,868
New Mexico	10.60	283,975	4,996	10.60	283,975	4,996
Arizona	46.24			46.24		
Idaho	88.93	2,587,356	6,750	129.13	2,800,014	6,612
Wyoming	22.91			22.91		
Nevada	11.27			11.27		
Utah	260.18			260.18		
PACIFIC:						
Washington	1,035.92	8,085,516	7,805	991.17	7,849,344	7,919
Oregon	544.64	5,197,688	9,543	549.19	5,221,202	9,507
California	2,605.28	33,294,496	12,780	2,605.28	33,294,496	12,780

[1] Excluding track located outside of state operated by companies in state and including track in state operated by outside companies.

The miles of outside trackage operated by companies within the state, and the miles of inside trackage operated by companies without the state, are shown in detail, by states, in Table 29 (p. 204). In the majority of cases the difference between the average based upon miles of track operated by companies in the state and the average based upon the actual miles of track within the state is not marked. New York is not materially affected, although there were 133.12 miles of track outside of the state in Connecticut, New Jersey, Pennsylvania, and Canada operated by companies in the state, and but 13.49 miles of track in the state operated by outside companies (Pennsylvania). For New Jersey, however, the average per mile of track is increased from $13,447 to $15,105, largely on account of the heavy traffic in and out of New York City, and the average for Pennsylvania is decreased from $13,015 to $12,827. Kansas shows an increase from $5,740 to $7,921, chiefly on account of traffic tributary to Kansas City, Mo.

The largest average income per mile of track from railway operations is, of course, found in New York City. The Interborough Rapid Transit, the Hudson and Manhattan, and the Brooklyn Heights Railroad Co., operating in the aggregate 494.42 miles of track, averaged $115,552 per mile. The averages for the Philadelphia Rapid Transit, the Boston Elevated, the Chicago City Railways Co., and the Chicago Railways Co. ranged from $31,000 to $35,000 per mile of track, the four roads operating in the aggregate 1,980.08 miles of track, with an average income per mile from railway operations of $33,752.

Earnings per car-mile.—Table 124 shows the operating revenues, operating expenses, and net revenue per car-mile for 1912, 1907, and 1902, for all companies and for classes A, B, and C, and the increase during the five-year periods.

Table 124	OPERATING REVENUES, OPERATING EXPENSES, AND NET REVENUE PER CAR-MILE.					
CLASS AND ACCOUNT.	1912	1907	1902	Increase.		
				1902–1912	1907–1912	1902–1907
All companies:	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Operating revenues	29.53	25.97	21.87	7.66	3.56	4.10
Operating revenues exclusive of income from sale of current	27.63	24.72	21.19	6.44	2.91	3.53
Operating expenses	17.32	15.61	12.57	4.75	1.71	3.04
Net operating revenue	12.21	10.36	9.30	2.91	1.85	1.06
Classified according to income from railway operations:						
Class A—						
Operating revenues	29.49	26.25	22.92	6.57	3.24	3.33
Operating revenues exclusive of income from sale of current	28.25	25.58	22.63	5.62	2.67	2.95
Operating expenses	16.72	15.32	12.55	4.17	1.40	2.77
Net operating revenue	12.77	10.93	10.37	2.40	1.84	0.56
Class B—						
Operating revenues	30.63	25.71	21.21	9.42	4.92	4.50
Operating revenues exclusive of income from sale of current	27.18	23.80	20.29	6.89	3.38	3.51
Operating expenses	18.91	15.91	12.46	6.45	3.00	3.45
Net operating revenue	11.72	9.80	8.75	2.97	1.92	1.05
Class C—						
Operating revenues	28.32	24.84	18.85	9.47	3.48	5.99
Operating revenues exclusive of income from sale of current	23.94	21.36	17.04	6.90	2.58	4.32
Operating expenses	19.33	16.74	12.75	6.58	2.59	3.99
Net operating revenue	8.99	8.10	6.10	2.89	0.89	2.00

It is noticeable that every average based on the car-mile as a standard shows an increase for 1912 over 1907 and for 1907 as compared with 1902. The increase is nearly uniform for all classes, although for the decade 1902–1912 the increments for operating revenues, operating revenues exclusive of sale of current, and operating expenses are highest for class C and lowest for class A. With respect to the increase in net revenue per car-mile, the gain during the decade was 2.97 cents for class B, as compared with 2.89 cents for class C and 2.4 cents for class A.

Earnings per passenger.[1]—The average earnings per revenue passenger for 1912 were slightly in excess of those for 1907, and in like manner the earnings for 1907 exceeded those for 1902. Urban traffic is the predominating factor, and the averages are influenced largely by the almost universal 5-cent fare for urban passengers. Variations therefrom are due to conditions heretofore described.

Table 125 shows the average operating revenue and expense per revenue passenger for 1912, 1907, and 1902, for all companies, for classes A, B, and C, and for elevated and subway lines.

Table 125	AVERAGE OPERATING REVENUES, OPERATING EXPENSES, AND NET OPERATING REVENUE PER REVENUE PASSENGER.					
CLASS AND ACCOUNT.	1912	1907	1902	Increase.[1]		
				1902–1912	1907–1912	1902–1907
All companies:	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Operating revenues	5.95	5.63	5.23	0.72	0.32	0.40
Passenger	5.27	5.15	4.94	0.33	0.12	0.21
All other	0.68	0.49	0.29	0.39	0.19	0.20
Operating expenses	3.49	3.39	3.01	0.48	0.10	0.38
Net operating revenue	2.46	2.25	2.23	0.22	0.21	0.02
Class A—						
Operating revenues	5.54	5.28	5.00	0.54	0.26	0.28
Passenger	5.08	4.99	4.84	0.24	0.09	0.15
All other	0.46	0.30	0.16	0.30	0.16	0.14
Operating expenses	3.14	3.08	2.74	0.40	0.06	0.34
Net operating revenue	2.40	2.20	2.26	0.14	0.20	−0.06
Class B—						
Operating revenues	7.51	6.53	5.57	1.94	0.98	0.96
Passenger	6.10	5.69	5.16	0.94	0.41	0.53
All other	1.41	0.84	0.42	0.99	0.57	0.42
Operating expenses	4.64	4.04	3.28	1.36	0.60	0.76
Net operating revenue	2.87	2.49	2.30	0.57	0.38	0.19
Class C—						
Operating revenues	7.68	6.99	6.08	1.60	0.69	0.91
Passenger	5.87	5.61	5.24	0.63	0.26	0.37
All other	1.80	1.38	0.84	0.96	0.42	0.54
Operating expenses	5.24	4.71	4.11	1.13	0.53	0.60
Net operating revenue	2.44	2.28	1.96	0.48	0.16	0.32
Elevated and subway—						
Operating revenues	5.27	5.33	(2)	....	−0.06	....
Passenger	5.08	4.97	(2)	....	0.11	....
All other	0.19	0.36	(2)	....	−0.17	....
Operating expenses	2.38	2.38	(2)	....	....	....
Net operating revenue	2.89	2.95	(2)	....	−0.06	....

[1] A minus sign (−) denotes decrease.

[2] Figures not available.

The effect of long rides on the statistics shows to a slight extent in the average for companies of class B, which class includes many of the interurban lines, while the large city systems are in class A. The elevated and subway group, for which the average passenger revenue was 5.08 cents for 1912, as compared with 4.97 cents in 1907, is purely urban in character.

The statistics indicate an increase in operating expense per passenger for all classes of roads, with the exception of the small elevated and subway group. It is generally recognized that in most cities the length of haul per passenger has increased steadily with the expansion of area served. The area within which a single fare applies has expanded, resulting in a demand for increased service facilities at the same price, and manifestly there is a point beyond which this expansion can not go without a readjustment of rates.

In the case of roads doing an urban railway business, an analysis of their revenues and disposition of income on a revenue passenger basis may throw some light upon general conditions.

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[1] See "Passenger traffic and fares," p. 414.

Table 126 shows, by states, the average gross income and the distribution of the income per revenue passenger, for companies operating city and suburban trackage only and not engaged in the sale of electric current. These form a group of companies engaged essentially in urban traffic, which, as a rule, charge a single unit fare or count passengers by the zone system.

Table 126

CLASS AND STATE.	OPERATING COMPANIES—AVERAGE INCOME, EXPENSES, NET INCOME, AND DIVIDENDS PER REVENUE PASSENGER: 1912.										DIVIDEND RATE (PER CENT).		
	Number of companies.	Number of revenue passengers.	Gross income.	Expenses.			Net income.	Dividends.	Surplus.	Dividends in excess of net income.	Computed on total outstanding capital stock of all companies exclusive of treasury stock.	Companies paying dividends.	
				Total.	Operating expenses.	Deductions from income, taxes and fixed charges.						Number.	Computed on total outstanding capital stock exclusive of treasury stock.
			Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*			
All companies	975	9,545,554,667	6.14	5.49	3.49	2.00	0.65	0.54	0.09	....	2.68	292	4.85
All companies without commercial lighting (class X)	760	8,341,549,514	5.72	5.17	3.28	1.89	0.54	0.47	0.07	....	2.66	220	5.13
Companies operating city and suburban trackage only, and without commercial lighting (class X)—selected states:													
California	20	370,368,211	5.10	4.63	3.07	1.56	0.47	0.30	0.17	....	1.37	5	1.70
Illinois	29	832,514,391	5.27	4.80	2.73	2.07	0.47	0.52	....	0.05	5.11	12	6.18
Kansas	6	19,644,644	5.06	3.90	2.67	1.23	1.16	0.02	1.14	....	0.20	1	2.67
Kentucky	7	93,727,509	5.39	4.32	3.10	1.22	1.07	1.09	....	0.02	8.37	3	8.74
Massachusetts	26	428,907,422	5.30	4.97	3.56	1.41	0.33	0.45	....	0.12	5.72	16	5.96
Minnesota	7	185,606,061	5.07	4.05	3.06	0.99	1.02	0.90	0.12	....	6.60	3	6.69
Missouri	8	265,966,645	5.05	4.58	3.20	1.38	0.47	0.04	0.43	....	0.22	1	2.67
New Jersey	13	318,015,275	5.07	4.89	2.88	2.01	0.18	0.19	....	0.01	1.50	2	1.60
New York	59	1,656,849,982	5.40	4.81	2.88	1.93	0.59	0.52	0.07	....	6.06	11	9.87
Ohio	14	357,060,894	4.25	3.49	2.56	0.93	0.76	0.59	0.17	....	5.01	10	5.09
Pennsylvania	54	578,779,510	5.22	5.07	2.76	2.31	0.15	0.11	0.04	....	1.09	18	4.23
Texas	22	84,096,967	5.04	4.51	3.45	1.06	0.53	0.22	0.31	....	1.99	3	3.91
Virginia	7	9,356,894	6.87	7.42	5.75	1.67	[1] 0.55	0.15	....	[2] 0.70	0.42	1	3.50
Wisconsin	10	105,995,804	4.45	3.72	2.32	1.40	0.73	0.77	....	0.04	7.02	4	7.24

[1] Deficit.

[2] Deficit plus dividends.

Of the 282 companies which operated city and suburban trackage only and which did not do commercial lighting, 90 paid dividends and 192 did not report the payment of dividends. In the case of seven states the dividend rate computed on the capital stock of the companies paying dividends was less than 5 per cent, these seven states representing 130 companies and 31 dividend-paying companies.

The dividends paid exceeded the net income for the year in the case of six of these states, and in two of the remaining states the surplus was less than one-tenth of a cent per revenue passenger.

Operating ratio.—Operating ratio statistics have been heretofore presented in connection with different sections of this report, but are here assembled for convenience of reference. A comparison of the ratio of operating expenses to operating revenues for the different groups of companies indicates to some extent the effect of efficiency of management and density of traffic upon their financial showing. The operating ratio depends upon two factors—expenses and revenues—and a high or low operating ratio may point either to high or low expenses or to low or high revenues. As a rule, the operating ratio is lower in the larger than in the smaller cities, owing largely to the fact that the density of traffic varies more or less directly with the density of population. As to expenses, the wages per employee range higher in the larger cities than in small cities or in rural districts, and interruptions to traffic and obstructions retarding speed on surface lines are more prevalent in the larger cities, all of which circumstances tend to increase the average operating expense; but the effect of these conditions upon the operating ratio is offset by the larger number of passengers carried per car-mile and the greater passenger revenue due to the greater density of traffic. Some of the factors that tend to vitiate operating ratio comparisons are the nonrailway activities of some railway companies, such as the sale of electric current, the operation of pleasure resorts, etc. Furthermore, freight, mail, and express businesses are prominent elements in some cases and absent in others. Interurban railways are in many respects more closely allied with steam railroads than with urban street railways, and the conditions under which elevated and subway roads operate are very different from those in the case of surface lines.

Table 127 assembles the operating ratio statistics for the various classified groups of companies.

The expense factor of the operating ratio does not include taxes, these being included with interest and other fixed charges. The ratios for 1912, as a general rule, are lower than those for 1907 and higher than those for 1902, and the range covered by these figures for the several divisions is somewhat narrower for 1912 than for the earlier years.

The ratio of net revenue from operation to total operating revenues is very obviously the complement of the operating ratio, and therefore as the operating ratio increases the net revenue ratio decreases.

Table 127

DIVISION AND CLASS.	OPERATING RATIOS. 1912	1907	1902
ALL COMPANIES.			
United States	58.7	60.1	57.5
New England	66.0	67.8	68.8
Middle Atlantic	56.7	57.6	54.8
East North Central	58.2	60.7	56.6
West North Central	61.0	54.1	55.5
South Atlantic	54.7	57.1	54.6
East South Central	57.8	60.2	56.6
West South Central	61.0	61.2	61.5
Mountain	57.9	57.1	61.7
Pacific	59.7	68.2	56.3
CLASSIFIED COMPANIES.			
Companies reporting net income	56.8	58.8	56.0
Companies reporting net deficit	71.6	64.7	67.5
Companies classified according to income from railway operations:			
Class A—$1,000,000 and over	56.7	58.4	54.8
Class B—$250,000 but less than $1,000,000	61.7	61.9	58.8
Class C—Less than $250,000	68.3	67.4	67.7
Companies without and with commercial lighting:			
Class X—Without commercial lighting	59.2	60.0	57.4
Class Y—With commercial lighting	56.0	60.3	58.1
Companies classified as—			
Elevated and subway	45.2	44.7	....
Surface	60.0	61.5	....

At the censuses of 1902 and 1907 an analysis of companies was made on the basis of their operating ratios. Table 128 shows the number of companies that had operating ratios falling within specified limits, for all companies for 1912, 1907, and 1902, and for company groups for 1912 and 1907.

Table 128

OPERATING RATIO (PER CENT).	DISTRIBUTION OF OPERATING COMPANIES WITH RESPECT TO OPERATING RATIO. 1912	1907	1902	Increase in number.[1] 1907–1912	1902–1907
Total—All companies	975	939	799	36	140
Operating ratio (per cent):					
Under 50	71	78	73	−7	5
50 but under 60	224	195	169	29	26
60 but under 70	232	263	216	−31	47
70 but under 80	177	160	121	17	39
80 but under 90	110	109	92	1	17
90 and over	161	134	128	27	6
Companies classified according to income from railway operations:					
Class A—$1,000,000 and over	91	76	(2)	15	....
Under 50	15	12	(2)	3	....
50 but under 60	44	29	(2)	15	....
60 but under 70	27	21	(2)	6	....
70 but under 80	4	10	(2)	−6	....
80 but under 90	....	4	(2)	−4	....
90 and over	1	....	(2)	1	....
Class B—$250,000 but less than $1,000,000	154	130	(2)	24	....
Under 50	20	10	(2)	10	....
50 but under 60	61	47	(2)	14	....
60 but under 70	37	46	(2)	−9	....
70 but under 80	19	20	(2)	−1	....
80 but under 90	13	6	(2)	7	....
90 and over	4	1	(2)	3	....
Class C—Less than $250,000	730	733	(2)	−3	....
Under 50	36	56	(2)	−20	....
50 but under 60	119	119	(2)	....	....
60 but under 70	168	196	(2)	−28	....
70 but under 80	154	130	(2)	24	....
80 but under 90	97	99	)2)	−2	....
90 and over	156	133	(2)	23	....
Companies classified as "Elevated and subway"	7	6	(2)	1	....
Under 50	3	3	(2)	....	....
50 but under 60	3	1	(2)	2	....
60 but under 70	....	2	(2)	−2	....
80 but under 90	1	....	(2)	1	....

[1] A minus sign (—) denotes decrease.

(2) Figures not available.

The group of companies reporting operating ratios of 60 per cent but under 70 contains the largest number of companies in any one group at all three censuses. Of the 271 companies with operating ratios of 80 and over in 1912, 253 are of class C, 17 of class B, and only 1 of class A.

If the numbers of companies in the income-class subgroups are superadded and expressed as cumulative percentages of the totals, the pronounced correlation between the magnitude of a company's operations and its operating ratio is brought out. This is done in the following tabular statement:

OPERATING RATIO (PER CENT).	PER CENT OF COMPANIES REPORTING SPECIFIED OPERATING RATIOS. Class A. 1912	Class A. 1907	Class B. 1912	Class B. 1907	Class C. 1912	Class C. 1907
Under 50	16	16	13	8	5	8
Under 60	65	54	53	44	21	24
Under 70	95	82	77	79	44	51
Under 80	99	95	89	95	65	68
Under 90	99	100	97	99	79	82

Although the operating ratios for individual companies vary greatly within each state, yet the ratio of operating expenses to operating revenues for all the railways of a state may be taken as a typical ratio for the state. State ratios of this character are presented in Table 158 (p. 302), and are reproduced in Table 129, the states being ranked according to operating ratios in 1912.

The average for the United States as a whole shows a decrease from 60.1 per cent in 1907 to 58.7 per cent in 1912, preceded by an increase from 1902 to 1907. Oregon shows the lowest operating ratio in 1912 (48.5 per cent), Nebraska the lowest in 1907 (48.4 per cent), and Minnesota the lowest in 1902 (46.1 per cent); while Arizona shows the highest ratios for all three years, 85.1, 83.8, and 84.7, respectively. Decreases appear for 26 states and increases for 22 states.

Table 129

STATE	OPERATING RATIO.[1] 1912	1907	1902
United States	58.7	60.1	57.5
Oregon	48.5	60.0	*62.7*
Utah	51.4	*61.5*	*63.6*
Maryland	51.7	50.2	47.2
Georgia	51.9	55.4	51.9
Wisconsin	52.3	52.7	51.1
West Virginia	52.9	60.1	*59.2*
Tennessee	53.2	54.8	*57.8*
District of Columbia	53.4	52.9	52.0
Delaware	54.3	*68.3*	*72.1*
Illinois	54.6	*63.3*	*58.4*
Arkansas	54.7	56.2	*58.2*
Colorado	56.0	50.8	*58.4*
New York	56.0	56.7	56.8
Washington	56.0	*65.1*	*62.0*
Nebraska	56.5	48.4	57.1
Virginia	56.6	*63.3*	*65.0*
Maine	56.9	*65.5*	*73.1*
Vermont	57.5	*71.1*	*80.7*
Pennsylvania	57.7	58.2	51.5
Alabama	58.0	*67.6*	*58.7*
Indiana	58.1	56.2	*58.2*
New Jersey	58.4	*61.3*	53.1
Florida	58.7	*70.0*	*64.1*
Kansas	*58.8*	53.8	*69.4*

[1] Italics indicate ratios above the average for the United States.

Table 129—Continued.

STATE.	OPERATING RATIO.[1] 1912	1907	1902
Kentucky	*60.1*	59.2	53.2
Louisiana	*60.8*	59.5	*60.4*
Minnesota	*60.8*	50.0	46.1
Iowa	*61.3*	*65.8*	*61.3*
Texas	*61.4*	*63.7*	*64.2*
Missouri	*61.9*	53.8	56.8
Ohio	*62.2*	*60.8*	55.1
Michigan	*63.0*	59.8	56.3
Connecticut	*63.5*	*66.8*	*64.7*
Rhode Island	*63.5*	*61.9*	*63.8*
California	*63.6*	*70.5*	54.2
North Dakota	*64.4*	*65.3*	....
North Carolina	*66.6*	*62.7*	73.7
Oklahoma	*67.1*	*63.4*	....
Massachusetts	*67.6*	*68.5*	*69.5*
South Carolina	*68.0*	59.9	*66.7*
Idaho	*70.1*	*61.8*	*60.9*
Mississippi	*72.5*	*65.4*	*74.3*
Montana	*73.0*	*72.6*	*74.2*
Nevada	*73.2*	*79.9*	....
South Dakota	*75.5*	52.5	....
New Hampshire	*79.3*	*82.3*	*79.3*
Wyoming	*80.1*	....	....
New Mexico	*83.5*	*69.7*	*71.5*
Arizona	*85.1*	*83.8*	*84.7*

[1] Italics indicate ratios above the average for the United States.

Relation of operating ratio to density of traffic.—One of the chief factors governing the ratio of operating expenses to operating revenues is density of traffic. A comparison of the number of revenue passengers carried per mile of track, which is a measure of traffic density, with the operating ratios shows, as a rule, that a decrease in the ratio accompanies an increase in traffic density; and a comparison of the number of revenue passengers carried per car-mile with the operating ratios shows a similar relation. Table 130 gives the number of companies, by ratio groups, distributed according to number of revenue passengers carried per mile of track, and according to number carried per car-mile.

It will be seen that the companies with low traffic densities have, proportionately, the largest representation in the high-ratio groups, while those with high traffic densities are, proportionately, the most numerous in the groups having low operating ratios. Thus, with respect to passengers per mile of track: The companies averaging fewer than 50,000 revenue passengers per mile of track, which constituted 33.6 per cent of all companies in 1912, comprised but 22.2 per cent of the companies with an operating ratio of less than 60 per cent, and 48.1 per cent of those with an operating ratio of 80 per cent and over.

Table 130

	TOTAL NUMBER OF COMPANIES.		NUMBER OF COMPANIES REPORTING OPERATING RATIO—											
			Under 50 per cent.		50 per cent but under 60 per cent.		60 per cent but under 70 per cent.		70 per cent but under 80 per cent.		80 per cent but under 90 per cent.		90 per cent and over.	
	1912	1907	1912	1907	1912	1907	1912	1907	1912	1907	1912	1907	1912	1907
Total number	[1] 973	[2] 938	69	77	224	195	233	263	177	160	109	109	161	134
Revenue passengers per mile of track:														
Under 25,000	184	169	4	11	31	27	50	45	25	26	26	21	48	39
25,000 but under 50,000	143	134	6	9	24	21	27	22	30	22	16	26	40	34
50,000 but under 100,000	242	232	13	19	40	39	61	73	46	37	37	25	45	39
100,000 but under 200,000	220	263	19	17	60	61	55	83	47	52	22	30	17	20
200,000 but under 300,000	95	67	11	7	33	20	23	23	16	12	6	3	6	2
300,000 but under 400,000	41	32	9	8	14	11	10	8	5	5	1	......	2	......
400,000 and over	48	41	7	6	22	16	7	9	8	6	1	4	3	......
Revenue passengers per car-mile:														
Under 2	157	144	4	6	28	26	34	35	27	23	17	19	47	35
2 but under 3	168	164	7	11	27	34	36	27	32	30	27	27	39	35
3 but under 4	194	217	10	15	38	30	40	68	43	36	25	36	38	32
4 but under 5	200	202	15	15	52	56	64	67	37	37	17	11	15	16
5 but under 6	137	122	16	17	43	26	37	41	18	23	15	7	8	8
6 but under 7	57	37	9	4	20	10	14	10	5	6	3	4	6	3
7 and over	60	52	8	9	16	13	8	15	15	5	5	5	8	5

[1] Not including 2 companies doing freight business only.

[2] Exclusive of 6 companies which failed to furnish this information, and 1 freight road.

In 1907 the companies averaging fewer than 50,000 revenue passengers per mile of track, which constituted 32.3 per cent of all companies, comprised 25 per cent of the companies with an operating ratio of less than 60 per cent, and 49.4 per cent of those with a ratio of 80 per cent and over. On the other hand, the roads averaging at least 300,000 fare passengers per mile of track, which constituted 9.1 per cent of all companies in 1912, comprised 17.7 per cent of the less than 60 per cent class, and but 2.6 per cent of the 80 per cent and over class; the 1907 proportions being 7.8 per cent of all companies, 15.1 per cent of the less than 60 per cent class, and 1.6 per cent of the 80 per cent and over class. Similar deductions can be made from the standpoint of revenue passengers per car-mile.

The effect of density of traffic upon financial accounts appears also when the ratios of operating expenses and deductions from income to total expenses are studied in connection with number of passengers per mile of track. Of roads operating under conditions otherwise similar, those with a heavy passenger traffic per mile of track report relatively small amounts for operating expenses and large amounts for fixed charges as compared with roads of low traffic density.

Table 131 shows the complementary ratios of operating expenses and fixed charges to the totals for the various income classes of roads, and the average number of revenue passengers per mile of track for the respective classes.

Table 131

	Census.	COMPLEMENTARY RATIOS OF OPERATING EXPENSES AND DEDUCTIONS FROM INCOME, AND PASSENGERS PER MILE OF TRACK, FOR COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS: 1912, 1907, AND 1902.			
		Total—All companies.	Class A. $1,000,000 and over.	Class B. $250,000 but less than $1,000,000.	Class C. Less than $250,000.
Revenue passengers per mile of track.	1912	232,556	358,372	118,998	75,484
	1907	216,522	361,701	123,390	74,788
	1902	212,217	399,058	150,218	74,009
Per cent of total expenses represented by—					
Operating expenses	1912	63.5	61.7	67.7	70.1
	1907	64.5	63.0	66.4	70.7
	1902	64.7	61.8	68.1	73.4
Deductions from income	1912	36.5	38.3	32.3	29.9
	1907	35.5	37.0	33.6	29.3
	1902	35.3	38.2	31.9	26.6

BALANCE SHEETS.

The balance sheets furnished to the Census Bureau show the financial condition of the companies at the end of the year covered by the reports, and the general balance sheets shown are constructed by aggregating the figures contained in the reports of the companies. Securities and other liabilities of one company to another are included in the statement of liabilities as reported by the debtor company and in the statement of assets as reported by the creditor company, although it may happen that the debtor company carries the securities at their face valuation and the creditor company at only a nominal valuation. Different methods of bookkeeping are reflected in the balance sheets, but the very general adoption of the standard classification of accounts and form of report prescribed by the American Street and Interurban Railway Accountants Association has tended toward uniformity in methods of bookkeeping, and reports deviating from the standard have been made to conform thereto, so far as possible.

Table 164 (p. 318) is a condensed balance sheet for operating and lessor companies combined, by geographic divisions and by states, for 1912, 1907, and 1902.

Table 165 (p. 322) is the balance sheet for operating and lessor companies combined, by geographic divisions and states, for 1912.

In Table 132 the statements furnished by all companies for 1912, 1907, and 1902 are combined and condensed in a net balance sheet.

STREET AND ELECTRIC RAILWAYS—NET BALANCE SHEET, OPERATING AND LESSOR COMPANIES: 1912, 1907, AND 1902.

Table 132

	Census.	Number of companies.	ASSETS.			Total—Assets or liabilities.	LIABILITIES.			
			Cost of construction, equipment, and real estate.	Other investments.	Current and other assets.		Capital stock.	Funded debt.	Unfunded debt, reserves, and current and other liabilities.	Net surplus.
Operating and lessor companies.	1912	1,260	$4,596,563,292	$465,250,414	$348,731,487	$5,410,545,193	$2,379,346,313	$2,329,221,828	$606,690,400	$95,286,652
	1907	[1] 1,230	3,637,668,708	374,664,197	251,528,687	4,263,861,592	2,031,986,366	1,672,959,930	488,471,004	70,444,292
	1902	[2] 967	2,167,634,077	152,513,997	213,699,184	2,533,847,258	1,266,883,289	974,112,422	252,145,435	40,706,112
Per cent of total	1912		85.0	8.6	6.4	100.0	44.0	43.0	11.2	1.8
	1907		85.3	8.8	5.9	100.0	47.7	39.2	11.5	1.7
	1902		85.5	6.0	8.4	100.0	50.0	38.4	10.0	1.6
Per cent of increase:										
1902–1912		30.3	112.1	205.1	63.2	113.5	87.8	139.1	140.6	134.1
1907–1912		2.4	26.4	24.2	38.6	26.9	17.1	39.2	24.2	35.3
1902–1907		27.2	67.8	145.7	17.7	68.3	60.4	71.7	93.7	73.1
Operating companies	1912	975	$3,867,215,202	$385,973,185	$331,692,759	$4,584,881,146	$1,957,300,149	$1,999,417,874	$553,451,347	$74,711,776
	1907	[1] 939	2,719,051,703	329,803,587	172,213,837	3,221,069,127	1,508,759,290	1,264,504,062	406,256,041	41,549,734
Per cent of total	1912		84.3	8.4	7.2	100.0	42.7	43.6	12.1	1.6
	1907		84.4	10.2	5.3	100.0	46.8	39.3	12.6	1.3
Per cent of increase: 1907–1912		3.8	42.2	17.0	92.6	42.3	29.7	58.1	36.2	79.8
Lessor companies	1912	285	$729,348,090	$79,277,229	$17,038,728	$825,664,047	$422,046,164	$329,803,954	$53,239,053	$20,574,876
	1907	291	918,617,005	44,860,610	79,314,850	1,042,792,465	523,227,076	408,455,868	82,214,963	28,894,558
Per cent of total	1912		88.3	9.6	2.1	100.0	51.1	39.9	6.4	2.5
	1907		88.1	4.3	7.6	100.0	50.2	39.2	7.9	2.8
Per cent of increase:[3] 1907–1912		−2.1	−20.6	76.7	−78.5	−20.8	−19.3	−19.3	−35.2	−28.8

[1] Exclusive of 6 companies which failed to furnish this information.

[2] Exclusive of 20 companies which failed to furnish this information.

[3] A minus sign (—) denotes decrease.

The designation "Net balance sheet" is used because the surplus shown is a net surplus obtained by deducting the sum of the deficits from the sum of the surpluses, the total assets and total liabilities being reduced by an amount equal to the sum of the deficits.

Assets.—The amount reported for cost of construction, equipment, and real estate should not be taken as representing the actual amount invested in way and structures and equipment. Consolidations make it difficult to secure true figures. In 1912 franchise values were largely carried as sundries, but it is a common practice to charge these values to cost of construction. Many of the street railway systems in the larger cities are the results of many consolidations, and the turnover in each instance has carried with it a large but unknown value for franchises, good will, etc., so that a considerable portion of the cost of construction and equipment as reported represents capitalized franchise values, etc. Hence, to secure uniformity in the exceptional cases where franchise values were reported separately, they have been added to the cost of construction and equipment. The amount reported as cost of construction, equipment, and real estate represents approximately the same proportion of the total assets in 1912, 1907, and 1902, the variation in the ratios being but one-half of 1 per cent. The increase in the amount reported was 112.1 per cent for the decade 1902–1912, as compared with an increase of 13.51 per cent in the total assets. The account of "Other investments" includes the detailed accounts designated in other tables as "Stocks and bonds of other electric railway companies," "Stocks and bonds of companies other than electric railways," "Treasury securities," and "Other permanent investments," while "Current and other assets" comprise the balance of the detail accounts. The total amount of "Other investments" in 1912 ($465,250,414) is an increase of 205.1 per cent over the amount reported in 1902. It constituted, however, only 8.6 per cent of the total assets in 1912, a larger proportion than in 1902, but a little less than in 1907.

Liabilities.—The ratio of capital stock to total liabilities is decreasing and the ratio of funded debt increasing. Capital stock constituted 44 per cent of the total liabilities in 1912, as compared with 47.7 per cent in 1907 and 50 per cent in 1902, while funded debt constituted 43 per cent in 1912, as compared with 39.2 and 38.4 per cent in the former years. Combined, there was but little change, the proportion of total liabilities represented by capitalization—capital stock and funded debt combined—being 87 per cent in 1912, as compared with 86.9 per cent in 1907 and 88.4 per cent in 1902, while the per cent of increase in capitalization for the decade was 110.1 per cent, as compared with an increase of 113.5 per cent for total liabilities and 112.1 per cent for cost of construction; but the per cent of increase for the decade for funded debt was 139.1 per cent and for capital stock 87.8 per cent. Differences in statements of accounts at different censuses render a comparison involving primary balance-sheet accounts of questionable value. The net surplus, $95,286,652, in 1912, is the resultant found by deducting the total profit and loss deficit from the total profit and loss surplus. In 1912, 787 companies showed balance-sheet surpluses to the amount of $133,436,096, and 352 companies balance-sheet deficits to the amount of $38,149,444, 121 companies showing balanced statements with neither profit and loss surplus nor deficit. In like manner, the net surplus of $70,444,292 in 1907 is the balance of surpluses to the amount of $106,623,225 over deficits to the amount of $36,178,933, 710 companies reporting surplus balances, 303 deficit balances, and 217 balanced statements with neither profit and loss surplus nor deficit. The distribution of the number of companies reporting surplus balances and deficit balances, by geographic divisions, for 1912, is shown in Table 133.

Table 133 NUMBER OF COMPANIES REPORTING SURPLUS BALANCES AND DEFICIT BALANCES: 1912.

DIVISION.	All companies.			Number reporting a profit and loss—						Number reporting balanced statements—neither surplus nor deficit.		
				Surplus.			Deficit.					
	Total.	Operating.	Lessor.	Total.	Operating.	Lessor.	Total.	Operating.	Lessor.	Total.	Operating.	Lessor.
United States....	1,260	975	285	787	641	146	352	310	42	121	24	97
New England..........	119	91	28	82	61	21	33	28	5	4	2	2
Middle Atlantic.........	436	246	190	239	146	93	123	92	31	74	8	66
East North Central....	253	222	31	172	157	15	64	61	3	17	4	13
West North Central....	90	85	5	63	60	3	21	21	....	6	4	2
South Atlantic..........	123	107	16	80	73	7	33	32	1	10	2	8
East South Central....	46	45	1	32	31	1	14	14	....	....	....	....
West South Central....	83	79	4	59	56	3	21	21	....	3	2	1
Mountain..............	42	40	2	21	21	....	19	18	1	2	1	1
Pacific.................	68	60	8	39	36	3	24	23	1	5	1	4

The increase in deficit balances for the period 1907–1912 was $1,970,511, and the increase in surplus balances was $26,812,871. The states showing net deficits in 1912 for the railway companies of each state as a whole were New Hampshire, Pennsylvania, Mississippi, New Mexico, Arizona, and Idaho. The deficit states in 1907 were Vermont and Delaware, and in 1902, New Jersey, Illinois, Kansas, North Carolina, and District of Columbia.

Balance sheet of operating and lessor companies.—The balance-sheet statistics for operating and lessor companies, though combined to show the aggregate for the industry, are somewhat different in character and are presented separately in Table 134 for 1912. Comparative statistics for 1907 are not given, on account of differences in accounts as reported for the two censuses.

The lessor companies represented 15.3 per cent of the combined balance-sheet totals, whereas in 1907 they represented 24.5 per cent. The bulk of the investments of the lessor companies in the stocks and bonds of other railway companies is confined to a comparatively few companies. Of the 285 lessor companies, only 28 reported such investments—the same number as in 1907; and of the total amount, $60,664,030, reported, $47,226,486, or nearly four-fifths, was returned by 15 lessor companies in Pennsylvania, four-fifths of this amount, in turn, being reported by two companies. Of the operating companies, 131 owned stocks and bonds in other electric railway companies to the amount of $206,298,309, as compared with 108 companies in 1907 to the amount of $180,941,984. The carrying of treasury stocks and bonds as assets by lessor companies was reported by 23 companies, but nearly one-half of the treasury securities so carried were reported by 1 company. The holdings of operating companies in treasury stocks and bonds, on the other hand, was distributed among 200 companies.

STREET AND ELECTRIC RAILWAYS—NET BALANCE SHEET, OPERATING AND LESSOR COMPANIES, BY ACCOUNTS: 1912.

Table 134

ACCOUNT.	Total—All companies.	Operating companies.	Lessor companies.	PER CENT OF TOTAL.	
				Operating companies.	Lessor companies.
Number of companies	1,260	975	285	77.4	22.6
Total—Assets or liabilities	$5,410,545,193	$4,584,881,146	$825,664,047	84.7	15.3
ASSETS.					
Cost of construction, equipment, and real estate	4,596,563,292	3,867,215,202	729,348,090	84.1	15.9
Stocks and bonds of other electric railway companies	266,962,339	206,298,309	60,664,030	77.3	22.7
Stocks and bonds of companies other than electric railways	57,774,666	53,238,280	4,536,386	92.1	7.9
Treasury securities	93,142,825	81,718,194	11,424,631	87.7	12.3
Stock	30,875,789	28,467,510	2,408,279	92.2	7.8
Bonds	62,267,036	53,250,684	9,016,352	85.5	14.5
Other permanent investments	47,370,584	44,718,402	2,652,182	94.4	5.6
Cash and current assets, including supplies	178,853,733	171,839,163	7,014,570	96.1	3.9
Stock and bond discount	67,754,310	67,271,214	483,096	99.3	0.7
Sinking and other special funds	27,761,430	26,203,287	1,558,143	94.4	5.6
Sundries	74,362,014	66,379,095	7,982,919	89.3	10.7
LIABILITIES.					
Capital stock	2,379,346,313	1,957,300,149	422,046,164	82.3	17.7
Common	1,970,385,003	1,606,071,539	364,313,464	81.5	18.5
Preferred	408,961,310	351,228,610	57,732,700	85.9	14.1
Funded debt	2,329,221,828	1,999,417,874	329,803,954	85.8	14.2
Real-estate mortgages	6,097,245	5,593,168	504,077	91.7	8.3
Floating debt	296,161,797	279,910,481	16,251,316	94.5	5.5
Reserves	80,775,824	77,275,608	3,500,216	95.7	4.3
Accounts payable	86,715,392	81,617,168	5,098,224	94.1	5.9
Interest and taxes due and accrued	54,079,730	52,882,137	1,197,593	97.8	2.2
Dividends due	4,164,748	4,011,405	153,343	96.3	3.7
Sundries	78,695,664	52,161,380	26,534,284	66.3	33.7
Net surplus	95,286,652	74,711,776	20,574,876	78.4	21.6

Table 135 shows the total debt of the operating and lessor companies, represented by funded debt, real estate mortgages, and floating debt, in 1912 and 1907, by geographic divisions.

Table 135

DIVISION.	Census	DEBT OF OPERATING AND LESSOR COMPANIES: 1912 AND 1907.			
		Total.	Funded debt.	Real-estate mortgages.	Floating debt.
United States	1912	$2,631,480,870	$2,329,221,828	$6,097,245	$296,161,797
	1907	1,955,946,832	1,672,959,930	4,059,805	278,927,097
New England	1912	148,135,670	129,639,840	330,842	18,164,988
	1907	146,201,708	130,606,958	269,032	15,325,718
Middle Atlantic	1912	951,252,709	801,582,533	4,229,917	145,440,259
	1907	689,051,342	557,410,106	2,376,778	129,264,458
East North Central	1912	623,356,959	589,361,398	381,621	33,613,940
	1907	482,373,354	436,565,900	1,140,536	44,666,918
West North Central	1912	175,940,636	155,092,155	605,830	20,242,651
	1907	151,032,942	130,583,800	29,100	20,420,042
South Atlantic	1912	218,740,732	205,449,168	403,100	12,888,464
	1907	165,512,631	151,682,049	76,900	13,753,682
East South Central	1912	75,153,648	71,296,580	22,285	3,834,783
	1907	58,821,027	53,758,167	17,000	5,045,860
West South Central	1912	76,228,219	65,691,669	58,050	10,478,500
	1907	54,287,979	45,827,950	57,357	8,402,672
Mountain	1912	54,906,270	46,014,459	....	8,891,811
	1907	33,094,273	29,699,600	....	3,394,673
Pacific	1912	307,766,027	265,094,026	65,600	42,606,401
	1907	175,571,576	136,825,400	93,102	38,653,074
PER CENT OF INCREASE, 1907–1912.[1]					
United States	......	34.5	39.2	50.2	6.2
New England	......	1.3	−0.7	23.0	18.5
Middle Atlantic	......	38.1	43.8	78.0	12.5
East North Central	......	29.2	35.0	−66.5	−24.7
West North Central	......	16.5	18.8	1,981.9	−0.9
South Atlantic	......	32.2	35.4	424.2	−6.3
East South Central	......	27.8	32.6	31.1	−24.0
West South Central	......	40.4	43.3	1.2	24.7
Mountain	......	65.9	54.9	....	161.9
Pacific	......	75.3	93.7	−29.5	10.2

[1] A minus sign (—) denotes decrease.

The interests of the lessor companies are, as a rule, confined to railway properties, their nonrailway investments in 1912 constituting but nine-tenths of 1 per cent of their total assets. Only 14 lessor companies reported investments in stocks and bonds of companies other than electric railways and 10 in "Other permanent investments."

The lessor companies represent proportionately less of the funded debt than of the capital stock, namely, 14.2 per cent of the total funded debt and 17.7 per cent of the total capital stock. There were 91 lessor companies and 194 operating companies in 1912 that reported no funded debt. Real-estate mortgages were reported by 10 and floating debt by 39 lessor companies. Of the total amount reported as sundry liabilities, $23,577,916, or nearly 90 per cent, was reported by Pennsylvania companies, and of this amount, $17,398,074 was reported by 3 companies.

The net surplus shown for lessor companies (Table 134) is the difference between an aggregate surplus of $24,125,159 reported by 146 companies and an aggregate deficit of $3,550,283 reported by 42 companies, the other 97 companies reporting neither surplus nor deficit. In 1907, 122 companies reported surpluses aggregating $32,201,859 and 38 companies deficits aggregating $3,307,301. Of the lessor companies reporting deficits in 1912, 15 were in Pennsylvania, 11 in New York, 5 in Massachusetts, 5 in New Jersey, 2 in Indiana, and 1 each in California, Idaho, Illinois, and Virginia.

Table 136 is an analysis of the surplus and deficit balances, for 1912 and 1907, and shows the number of companies reporting surplus balances, and deficit balances, respectively, and the per cent each is of the total number.

Table 136

	Census.	ANALYSIS OF SURPLUS AND DEFICIT BALANCES: 1912 AND 1907.				
		Total—All companies.	Operating companies.	Lessor companies.	Per cent of total.	
					Operating companies.	Lessor companies.
Number of companies.	1912	1,260	975	285	77.1	22.6
	1907	1,230	939	291	76.3	23.7
Net surplus	1912	$95,286,652	$74,711,776	$20,574,876	78.4	21.6
	1907	$70,444,292	$41,549,734	$28,894,558	59.0	41.0
Surplus:						
Number of companies.	1912	787	641	146	81.4	18.6
	1907	710	588	122	82.8	17.2
Per cent of total.	1912	62.5	65.7	51.2	....	....
	1907	57.7	62.6	41.9	....	....
Amount	1912	$133,436,096	$109,310,937	$24,125,159	81.9	18.1
	1907	$106,623,225	$74,421,366	$32,201,859	69.8	30.2
Deficit:						
Number of companies.	1912	352	310	42	88.1	11.9
	1907	303	265	38	87.5	12.5
Per cent of total.	1912	27.9	31.7	14.7	....	....
	1907	24.6	28.2	13.1	....	....
Amount	1912	$38,149,444	$34,599,161	$3,550,283	90.7	9.3
	1907	$36,178,933	$32,871,632	$3,307,301	90.9	9.1
Neither surplus nor deficit:						
Number of companies.	1912	121	24	97	19.8	80.2
	1907	217	86	131	39.6	60.4
Per cent of total.	1912	9.6	2.5	34.0	....	....
	1907	17.6	9.2	45.0	....	....

The per cent distribution of the total assets and total liabilities, respectively, among the several accounts for operating and lessor companies, for 1912, is given in Table 137.

Table 137

ACCOUNT.	PER CENT DISTRIBUTION OF ASSETS AND LIABILITIES: 1912.		
	Total—All companies.	Operating companies.	Lessor companies.
Assets, total	100.0	100.0	100.0
Cost of construction, equipment, and real estate	85.0	84.3	88.3
Stocks and bonds of other electric railway companies	4.9	4.5	7.3
Stocks and bonds of companies other than electric railways	1.1	1.2	0.5
Treasury securities	1.7	1.8	1.4
Other permanent investments	0.9	1.0	0.3
Cash and current assets, including supplies	3.3	3.7	0.8
Stock and bond discount	1.3	1.5	0.1
Sinking and other special funds	0.5	0.6	0.2
Sundries	1.4	1.4	1.0
Liabilities, total	100.0	100.0	100.0
Capital stock	44.0	42.7	51.1
Funded debt	43.0	43.6	39.9
Real-estate mortgages	0.1	0.1	0.1
Floating debt	5.5	6.1	2.0
Reserves	1.5	1.7	0.4
Accounts payable	1.6	1.8	0.6
Interest and taxes due and accrued	1.0	1.2	0.1
Dividends due	0.1	0.1	(1)
Sundries	1.5	1.1	3.2
Net surplus	1.8	1.6	2.5

[1] Less than one-tenth of 1 per cent.

Balance sheet, by states.—The increase in total assets and liabilities during the period 1907–1912 was, proportionately, the greatest in the Pacific, Mountain, and South Atlantic divisions, in the order named. The leading 10 states are ranked in the following tabular statement according to per cent of increase during the decade 1902–1912 and during the two five-year periods 1907–1912 and 1902–1907:

1902–1912		1907–1912		1902–1907	
State.	Per cent of increase.	State.	Per cent of increase.	State.	Per cent of increase.
Oklahoma	(1)	Oklahoma	200	Oregon	538
Oregon	1,184	North Carolina	168	Mississippi	500
Kansas	818	Georgia	140	Kansas	373
Washington	700	Washington	105	Arkansas	330
Mississippi	643	Oregon	101	Indiana	310
North Carolina	536	Kansas	94	Washington	290
California	483	Texas	78	California	255
Arkansas	479	Iowa	68	Louisiana	251
Indiana	387	West Virginia	66	Nebraska	191
West Virginia	324	California	64	Virginia	169

[1] No street or electric railways in 1902.

The leading 10 states ranked in like manner according to the amount of increase in assets and liabilities are as follows:

State.	Amount of increase.
1902–1912	
New York	$441,112,709
California	398,577,173
Pennsylvania	237,334,200
Ohio	217,194,193
Indiana	168,123,372
Illinois	161,689,619
Washington	140,283,646
Massachusetts	90,582,512
Oregon	77,733,105
Georgia	64,694,599
1907–1912	
New York	$209,660,803
California	187,579,444
Washington	82,216,537
Pennsylvania	62,743,072
Georgia	53,449,863
1907–1912—Continued.	
Massachusetts	$47,872,162
Oregon	42,433,043
Indiana	33,407,317
Illinois	31,857,219
Virginia	29,139,243
1902–1907	
New York	$231,451,906
California	210,997,729
Ohio	199,327,856
Pennsylvania	174,591,128
Indiana	134,716,055
Illinois	129,832,400
Louisiana	60,538,962
Washington	58,067,109
Massachusetts	42,710,350
Wisconsin	39,442,718

The heavy development in Ohio occurred during the period 1902–1907, and Georgia during the period 1907–1912.

A condensation of the balance-sheet statistics for the three census years is given in Table 138, by geographic divisions. On the assets side, the item "Other investments" includes the holdings of stocks and bonds of other companies, both railway and nonrailway, and other permanent investments and treasury securities, for 1912 and 1907. Treasury securities held as assets were not reported separately in 1902. The profit and loss surplus in every case is the net surplus.

CONDENSED NET BALANCE SHEET OF OPERATING AND LESSOR COMPANIES COMBINED, BY GEOGRAPHIC DIVISIONS: 1912, 1907, AND 1902.

Table 138

DIVISION.	Census.	Number of companies.	ASSETS.			Total assets or liabilities.	LIABILITIES.		
			Cost of construction, equipment, and real estate.	Other investments.	Current and other assets.		Capitalization.	Unfunded debt, reserves, and current and other liabilities.	Net profit and loss surplus.
UNITED STATES	1912	1,260	$4,596,563,292	$465,250,414	$348,731,487	$5,410,545,193	$4,708,568,141	$606,690,400	$95,286,652
	1907	[1] 1,230	$3,637,668,708	$374,664,197	$251,528,687	$4,263,861,592	$3,704,946,296	$488,471,004	$70,444,292
	1902	[2] 967	$2,167,634,077	$152,513,997	$213,699,184	$2,533,847,258	$2,240,995,711	$252,145,435	$40,706,112
Per cent of increase—									
1902–1912		30.3	112.1	204.9	63.2	113.5	110.1	140.6	134.1
1907–1912		2.4	26.4	24.2	38.6	26.9	27.1	24.2	35.3
1902–1907		27.2	67.8	145.7	17.7	68.3	65.3	93.7	73.1
GEOGRAPHIC DIVISIONS:									
New England	1912	119	$354,605,174	$13,591,713	$23,549,590	$391,746,477	$334,083,440	$48,492,176	$9,170,861
	1907	145	$286,023,884	$4,985,719	$18,911,758	$309,921,361	$268,765,346	$33,647,659	$7,508,356
	1902	166	$194,281,999	$2,893,501	$13,576,176	$210,751,676	$180,450,839	$27,386,093	$2,914,744
Per cent of increase [3]—									
1902–1912		−28.3	82.5	369.7	73.5	85.9	85.1	77.1	214.6
1907–1912		−17.9	24.0	172.6	24.5	26.4	24.3	44.1	22.1
1902–1907		−12.7	47.2	72.3	39.3	47.1	48.9	22.9	157.6
Middle Atlantic	1912	436	$1,471,795,717	$201,251,361	$127,930,909	$1,800,977,987	$1,513,580,910	$263,183,933	$24,213,144
	1907	450	$1,266,196,650	$113,030,336	$133,576,459	$1,512,803,445	$1,266,289,832	$226,811,383	$19,702,230
	1902	343	$894,650,238	$69,201,142	$120,260,275	$1,084,111,655	$914,955,559	$146,105,604	$23,050,492
Per cent of increase [3]—									
1902–1912		27.1	64.5	190.8	6.4	66.1	65.4	80.1	5.0
1907–1912		−3.1	16.2	78.1	−4.2	19.0	19.5	16.0	22.9
1902–1907		31.2	41.5	63.3	11.1	39.5	38.4	55.2	−14.5
East North Central	1912	253	$1,099,283,481	$98,896,346	$56,645,231	$1,254,825,058	$1,123,665,109	$105,915,709	$25,244,240
	1907	263	$970,924,964	$129,874,562	$32,500,080	$1,133,299,606	$1,026,261,945	$91,716,445	$15,321,216
	1902	189	$518,927,728	$44,172,172	$40,865,503	$603,965,403	$554,232,171	$46,119,544	$3,613,688
Per cent of increase [3]—									
1902–1912		33.9	111.8	123.9	38.6	107.8	102.7	129.7	598.5
1907–1912		−3.8	13.2	−23.9	74.3	10.7	9.5	15.5	64.8
1902–1907		39.2	87.1	155.8	−20.5	87.6	85.2	98.9	323.9
West North Central	1912	90	$336,808,451	$13,518,452	$14,077,887	$364,404,790	$314,339,675	$40,228,343	$9,836,772
	1907	77	$280,458,765	$5,804,107	$6,459,986	$292,722,858	$256,776,596	$29,812,516	$6,133,746
	1902	59	$186,626,205	$24,426,974	$9,466,756	$220,519,935	$205,210,574	$11,229,359	$4,080,002
Per cent of increase [3]—									
1902–1912		52.5	80.5	−44.7	48.7	64.8	53.2	258.3	141.1
1907–1912		16.9	20.1	132.9	117.9	24.5	22.4	34.9	60.4
1902–1907		30.5	50.3	−76.2	31.8	32.7	25.1	165.5	50.3
South Atlantic	1912	123	$375,467,897	$40,417,302	$31,574,545	$447,459,744	$402,016,673	$34,901,604	$10,541,467
	1907	110	$242,357,969	$32,955,988	$12,718,757	$288,032,714	$260,023,079	$21,600,176	$6,409,459
	1902	77	$162,507,589	$6,063,844	$6,560,203	$175,131,636	$167,107,079	$6,972,848	$1,051,709
Per cent of increase—									
1902–1912		59.7	125.5	566.5	381.3	155.5	140.6	400.5	902.3
1907–1912		11.8	54.9	22.6	148.3	55.4	54.6	61.6	64.5
1902–1907		42.9	49.1	443.5	93.9	64.5	55.6	209.8	509.4
East South Central	1912	46	$124,119,747	$10,299,276	$7,834,970	$142,253,993	$128,466,144	$10,394,792	$3,393,057
	1907	40	$107,392,029	$4,623,624	$3,625,222	$115,640,875	$104,223,447	$9,383,814	$2,033,614
	1902	34	$55,049,569	$1,686,255	$3,503,849	$60,239,673	$56,027,900	$2,786,504	$1,425,269
Per cent of increase—									
1902–1912		35.3	125.5	510.8	123.6	136.1	129.3	273.0	138.1
1907–1912		15.0	15.6	122.8	116.1	23.0	23.3	10.8	66.8
1902–1907		17.6	95.1	174.2	3.5	92.0	86.0	236.8	42.7
West South Central	1912	83	$136,295,611	$24,184,728	$12,792,829	$173,273,168	$152,233,874	$17,099,641	$3,939,653
	1907	51	$95,693,842	$30,838,166	$5,738,862	$132,270,870	$115,030,200	$12,978,346	$4,262,324
	1902	32	$32,245,293	$180,486	$10,597,959	$43,023,738	$37,542,000	$4,475,684	$1,006,054
Per cent of increase [3]—									
1902–1912		159.4	322.7	13,299.8	20.7	302.7	305.5	282.1	291.6
1907–1912		62.7	42.4	−21.6	122.9	31.0	32.3	31.8	−7.6
1902–1907		59.4	196.8	16,986.2	−45.9	207.4	206.4	190.0	323.7
Mountain	1912	42	$90,534,736	$18,588,315	$4,935,757	$114,058,808	$94,219,186	$14,407,043	$5,432,579
	1907	29	$50,578.599	$14,524,397	$3,168,522	$68,271,518	$60,132,051	$5,341,792	$2,797,675
	1902	18	$23,911,279	$1,892,662	$1,116,920	$26,920,861	$25,008,227	$1,341,791	$570,843
Per cent of increase—									
1902–1912		133.3	278.6	882.1	341.9	323.7	276.8	973.7	851.7
1907–1912		44.8	79.0	28.0	55.8	67.1	56.7	169.7	94.2
1902–1907		61.1	111.5	667.4	183.7	153.6	140.4	298.1	390.1
Pacific	1912	68	$607,652,478	$44,502,921	$69,389,769	$721,545,168	$645,963,130	$72,067,159	$3,514,879
	1907	65	$338,042,006	$38,027,298	$34,829,041	$410,898,345	$347,443,800	$57,178,873	$6,275,672
	1902	49	$99,434,177	$1,996,961	$7,751,543	$109,182,681	$100,461,362	$5,728,008	$2,993,311
Per cent of increase [3]—									
1902–1912		38.8	511.1	2,128.5	795.2	560.9	543.0	1,158.2	17.4
1907–1912		4.6	79.8	17.0	99.2	75.6	85.9	26.0	−44.0
1902–1907		32.7	240.0	1,804.3	349.3	276.3	245.8	898.2	109.7

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[1] Exclusive of 6 companies which failed to furnish this information.

[2] Exclusive of 20 companies which failed to furnish this information.

[3] A minus sign (−) denotes decrease.

CHAPTER VIII.

EMPLOYEES, SALARIES, AND WAGES.

Character of the statistics.—The schedule used at the present census called for the average number employed on September 16 of the census year, or, if data were not available for that day, the number for the nearest representative or normal day. The schedule used at the censuses of 1907 and 1902 called for the average number employed during the year, but many companies contended that it was impracticable to compute such an average, and September 16 was therefore adopted as a normal date, considering all industries and all localities, at the census of 1912. Separate totals were required for three classes of salaried employees—that is, salaried officers of corporations, managers and superintendents, and clerks, stenographers, and other salaried employees. Separate totals were also required for three classes of wage earners—conductors, motormen, and all other employees. In 1907 and in 1902 wage earners were grouped, by occupation, into a number of classes, but except for conductors and motormen the grouping was unsatisfactory, as among the small and medium-size companies one employee acts in several capacities. The change in the form of the inquiry may have some effect on the numbers reported for the different classes at the census of 1912, as compared with prior censuses. It may be that in some cases foremen, inspectors, starters, and engineers, that were specified as wage earners in the schedules for 1902 and 1907, were considered salaried employees in 1912 and reported as such. Table 139 gives the comparative statistics for the United States for the three census years.

The employees represent those engaged in the operation and maintenance of the street and electric railways, including those employed in making ordinary repairs and replacements, and those employed in the operation and maintenance of light and power departments of electric railways not repairable from railway operations.

STREET AND ELECTRIC RAILWAYS—EMPLOYEES, BY CLASSES OF OCCUPATION.

Table 139

CLASS.	1912	1907	1902	PER CENT OF INCREASE. 1902–1912	1907–1912	1902–1907
Number of companies	975	[1] 939	[2] 797	22.3	3.8	17.8
Persons employed:						
Number	282,461	221,429	140,769	100.7	27.6	57.3
Salaries and wages	$200,890,939	$150,991,099	$88,210,165	127.7	33.0	71.2
Salaried employees—						
Number	23,271	11,700	7,128	226.5	98.9	64.1
Salaries	$26,128,786	$12,909,466	$7,439,716	251.2	102.4	73.5
Salaried officers of corporation—						
Number	1,927	1,518	1,480	30.2	26.9	2.6
Salaries	$5,708,553	$3,852,252	$2,990,745	90.9	48.2	28.8
Managers and superintendents—						
Number	2,882	2,094	1,327	117.2	37.6	57.8
Salaries	$5,376,526	$3,580,367	$1,819,166	195.5	50.2	96.8
Clerks, stenographers, and other salaried employees—						
Number	18,462	8,088	4,321	327.3	128.3	87.2
Salaries	$15,043,707	$5,476,847	$2,629,805	472.0	174.7	108.3
Wage earners—						
Average number	[3] 259,190	209,729	133,641	93.9	23.6	56.9
Wages	$174,762,153	$138,081,633	$80,770,449	116.4	26.6	71.0
Conductors and motormen—						
Average number	131,321	115,518	80,144	63.9	13.7	44.1
Wages	$95,451,625	$75,705,054	$48,642,359	96.2	26.1	55.6
Conductors—						
Average number	65,726	60,032	40,141	63.7	9.5	49.6
Wages	$47,101,768	$38,234,158	$24,025,204	96.1	23.2	59.1
Motormen—						
Average number	65,595	55,486	40,003	64.0	18.2	38.7
Wages	$48,349,857	$37,470,896	$24,617,155	96.4	29.0	52.2
All other employees—						
Average number	127,869	94,211	53,497	139.0	35.7	76.1
Wages	$79,310,528	$62,376,579	$32,128,090	146.9	27.1	94.1

[1] Exclusive of 6 companies which failed to furnish this information.
[2] Exclusive of 20 companies which failed to furnish this information.
[3] Number employed Sept. 16, 1912.

The street and electric railways gave employment to 282,461 persons in 1912, as compared with 140,769 in 1902, the increase being 100.7 per cent. During the same time the amount paid in salaries and wages increased 127.7 per cent. Although variations in methods of classifying at different censuses may affect some of the groupings, yet conductors and motormen form a clearly defined class, for which the increase during the decade was 63.9 per cent in number, and 96.2 per cent in wages. The per cent distribution of total salaries and wages is shown in Table 140.

Table 140

	PER CENT DISTRIBUTION OF SALARIES AND WAGES. 1912	1907	1902
Total salaries and wages	100.0	100.0	100.0
Salaries	13.0	8.5	8.4
Officers of corporation	2.8	2.5	3.4
Managers and superintendents	2.7	2.4	2.0
Clerks, stenographers, and other salaried employees	7.5	3.6	3.0
Wages	87.0	91.5	91.6
Conductors and motormen	47.5	50.1	55.1
Conductors	23.4	25.3	27.2
Motormen	24.1	24.8	27.9
All other employees	39.5	41.4	36.5

The wages paid to conductors and motormen constituted 47.5 per cent of the total salaries and wages in 1912, as compared with 50.1 per cent in 1907 and 55.1 per cent in 1902.

Table 141 gives the comparative statistics for employees, salaries, and wages, by geographic divisions, and Table 142 the percentages of increase for the major groups of employees.

EMPLOYEES, SALARIES, AND WAGES OF OPERATING COMPANIES, BY CLASSES OF OCCUPATION, BY GEOGRAPHIC DIVISIONS: 1912, 1907, AND 1902.

Table 141	Census.	United States.	GEOGRAPHIC DIVISIONS.								
			New England.	Middle Atlantic.	East North Central.	West North Central.	South Atlantic.	East South Central.	West South Central.	Mountain.	Pacific.
Number of companies	1912	975	91	246	222	85	107	45	79	40	60
	1907	[1] 939	118	247	220	73	100	40	50	28	63
	1902	[2] 797	137	218	177	58	75	34	32	18	48
Persons employed: Number	1912	282,461	34,224	93,811	66,721	20,930	19,958	9,375	8,393	4,498	24,551
	1907	221,429	28,146	79,457	51,028	14,892	15,044	6,935	6,118	3,001	16,808
	1902	140,769	20,867	55,061	29,893	9,512	9,839	3,780	2,951	1,560	7,306
Salaries and wages	1912	$200,890,939	$23,285,975	$66,387,065	$47,607,646	$15,986,008	$12,501,028	$5,824,724	$5,717,503	$3,997,836	$19,583,154
	1907	$150,991,099	$19,373,192	$52,420,842	$34,902,979	$10,856,438	$9,152,807	$4,116,560	$3,794,223	$2,610,550	$13,763,508
	1902	$88,210,165	$13,640,549	$33,635,995	$19,137,389	$6,296,257	$5,032,132	$1,986,846	$1,895,591	$1,240,552	$5,344,854
Salaried employees—Number	1912	23,271	1,991	6,895	5,414	1,659	2,158	780	810	494	3,070
	1907	11,700	1,550	3,304	2,730	745	1,002	386	336	288	1,359
	1902	7,128	1,233	2,268	1,703	499	606	186	151	103	379
Salaries	1912	$26,128,786	$2,329,050	$8,071,703	$5,774,907	$1,925,201	$2,231,507	$953,189	$901,842	$614,107	$3,327,280
	1907	$12,909,466	$1,515,565	$3,418,274	$3,076,248	$1,012,565	$1,192,053	$460,596	$390,150	$367,524	$1,476,491
	1902	$7,439,716	$1,270,105	$2,178,925	$1,801,409	$590,791	$589,114	$221,075	$197,576	$127,549	$463,172
Salaried officers of corporation—Number	1912	1,927	144	511	576	138	209	102	72	51	124
	1907	1,518	227	400	388	93	168	74	47	40	81
	1902	1,480	238	393	363	98	159	64	53	30	82
Salaries	1912	$5,708,553	$457,562	$1,656,386	$1,466,386	$487,538	$555,166	$298,183	$162,055	$129,304	$495,973
	1907	$3,852,252	$451,852	$947,830	$1,076,332	$368,134	$377,451	$161,045	$109,857	$97,355	$262,396
	1902	$2,990,745	$458,448	$758,408	$780,178	$260,709	$260,940	$114,567	$119,289	$63,070	$175,136
Managers and superintendents—Number	1912	2,882	262	726	836	214	328	111	149	66	190
	1907	2,094	259	552	555	139	199	79	82	54	175
	1902	1,327	290	369	286	120	108	35	25	16	78
Salaries	1912	$5,376,526	$511,810	$1,509,255	$1,394,639	$400,933	$549,847	$191,850	$233,020	$147,829	$437,343
	1907	$3,580,367	$393,923	$913,932	$874,756	$258,429	$355,557	$131,752	$148,995	$114,264	$388,759
	1902	$1,819,166	$336,154	$558,870	$396,162	$154,339	$140,131	$51,393	$28,445	$23,316	$130,356
Clerks, stenographers, and other salaried employees—Number	1912	18,462	1,585	5,658	4,002	1,307	1,621	567	589	377	2,756
	1907	8,088	1,064	2,352	1,787	513	635	233	207	194	1,103
	1902	4,321	705	1,506	1,054	281	339	87	73	57	219
Salaries	1912	$15,043,707	$1,359,678	$4,906,062	$2,913,882	$1,036,730	$1,126,494	$463,156	$506,767	$336,974	$2,393,964
	1907	$5,476,847	$669,790	$1,556,512	$1,125,160	$386,002	$459,045	$167,799	$131,298	$155,905	$825,336
	1902	$2,629,805	$475,503	$861,647	$625,069	$175,743	$188,043	$55,115	$49,842	$41,163	$157,680
Wage earners—Average number	1912	[3] 259,190	32,233	86,916	61,307	19,271	17,800	8,595	7,583	4,004	21,481
	1907	209,729	26,596	76,153	48,298	14,147	14,042	6,549	5,782	2,713	15,449
	1902	133,641	19,634	52,793	28,190	9,013	9,233	3,594	2,800	1,457	6,927
Wages	1912	$174,762,153	$20,956,925	$58,315,362	$41,832,739	$14,060,807	$10,269,521	$4,871,535	$4,815,661	$3,383,729	$16,255,874
	1907	$138,081,633	$17,857,627	$49,002,568	$31,826,731	$9,843,873	$7,960,754	$3,655,964	$3,404,073	$2,243,026	$12,287,017
	1902	$80,770,449	$12,370,444	$31,457,070	$17,335,980	$5,705,466	$4,443,018	$1,765,771	$1,698,015	$1,113,003	$4,881,682
Conductors and motormen—Average number	1912	131,321	16,670	41,794	30,366	10,742	9,587	4,353	4,479	2,017	11,313
	1907	115,518	14,727	41,337	26,071	8,354	7,902	3,847	3,600	1,630	8,050
	1902	80,144	11,360	31,858	16,245	5,802	5,512	2,112	1,783	918	4,554
Wages	1912	$95,451,625	$10,819,328	$30,628,007	$23,486,192	$7,806,487	$5,938,195	$2,613,888	$3,043,211	$1,777,500	$9,338,817
	1907	$75,705,054	$9,754,035	$25,970,806	$17,709,200	$5,877,685	$4,439,698	$2,130,542	$2,048,591	$1,307,431	$6,467,066
	1902	$48,642,359	$7,349,409	$18,965,007	$10,464,524	$3,530,890	$2,578,556	$979,675	$1,074,761	$713,449	$2,986,088
Conductors—Average number	1912	65,726	8,219	21,135	15,151	5,358	4,779	2,152	2,176	1,014	5,742
	1907	60,032	7,447	22,439	13,563	4,150	3,906	1,902	1,772	817	4,036
	1902	40,141	5,724	15,957	8,386	2,848	2,788	907	811	450	2,270
Wages	1912	$47,101,768	$5,297,309	$15,088,922	$11,573,262	$3,815,365	$2,973,094	$1,285,141	$1,471,483	$889,829	$4,707,363
	1907	$38,234,158	$4,858,874	$13,353,043	$9,008,366	$2,894,309	$2,187,020	$1,047,481	$997,002	$653,163	$3,234,900
	1902	$24,025,204	$3,650,920	$9,340,475	$5,301,874	$1,732,394	$1,277,248	$384,335	$497,050	$350,850	$1,490,058
Motormen—Average number	1912	65,595	8,451	20,659	15,215	5,384	4,808	2,201	2,303	1,003	5,571
	1907	55,486	7,280	18,898	12,508	4,204	3,996	1,945	1,828	813	4,014
	1902	40,003	5,636	15,901	7,859	2,954	2,724	1,205	972	468	2,284
Wages	1912	$48,349,857	$5,522,019	$15,539,085	$11,912,930	$3,991,122	$2,965,101	$1,328,747	$1,571,728	$887,671	$4,631,454
	1907	$37,470,896	$4,895,161	$12,617,763	$8,700,834	$2,983,376	$2,252,678	$1,083,061	$1,051,589	$654,268	$3,232,166
	1902	$24,617,155	$3,698,489	$9,624,532	$5,162,650	$1,798,496	$1,301,308	$595,340	$577,711	$362,599	$1,496,030
All other employees—Average number	1912	127,869	15,563	45,122	30,941	8,529	8,213	4,242	3,104	1,987	10,168
	1907	94,211	11,869	34,816	22,227	5,793	6,140	2,702	2,182	1,083	7,399
	1902	53,497	8,274	20,935	11,945	3,211	3,721	1,482	1,017	539	2,373
Wages	1912	$79,310,528	$10,137,597	$27,687,355	$18,346,547	$6,254,320	$4,331,326	$2,257,647	$1,772,450	$1,606,229	$6,917,057
	1907	$62,376,579	$8,103,592	$23,031,762	$14,117,531	$3,966,188	$3,521,056	$1,525,422	$1,355,482	$935,595	$5,819,951
	1902	$32,128,090	$5,021,035	$12,492,063	$6,871,456	$2,174,576	$1,864,462	$786,096	$623,254	$399,554	$1,895,594

[1] Exclusive of 6 companies which failed to furnish this information.
[2] Exclusive of 20 companies which failed to furnish this information.
[3] Number employed Sept. 16, 1912.

Table 142 EMPLOYEES, SALARIES, AND WAGES OF OPERATING COMPANIES—PER CENT OF INCREASE (BASED ON TABLE 141).

DIVISION.	Persons employed.		Salaried employees.		Wage earners.			
					Conductors and motormen.		All other employees.	
	Number.	Salaries and wages.	Number.	Salaries.	Number.	Wages.	Number.	Wages.
United States:								
1902–1912	100.6	127.7	226.5	251.2	63.9	96.2	139.0	146.9
1907–1912	27.6	33.0	98.9	102.4	13.7	26.1	35.7	27.1
1902–1907	57.3	71.2	64.1	73.5	44.1	55.6	76.1	94.1
New England:								
1902–1912	64.0	70.7	61.5	83.4	46.7	47.2	88.1	101.9
1907–1912	21.6	20.2	28.5	53.7	13.2	10.9	31.1	25.1
1902–1907	34.9	42.0	25.7	19.3	29.6	32.7	43.4	61.4
Middle Atlantic:								
1902–1912	70.4	97.4	204.0	270.4	31.2	61.5	115.5	121.6
1907–1912	18.1	26.6	108.7	136.1	1.1	13.0	29.6	20.2
1902–1907	44.3	55.8	45.7	56.9	29.8	43.0	66.3	84.4
East North Central:								
1902–1912	123.2	148.8	217.9	220.6	86.9	124.4	159.0	167.0
1907–1912	30.8	36.4	98.3	87.7	16.5	32.6	39.2	30.0
1902–1907	70.7	82.4	60.3	70.8	60.5	69.2	86.1	105.5
West North Central:								
1902–1912	120.0	153.9	232.5	225.9	85.1	121.1	165.6	187.6
1907–1912	40.5	47.2	122.7	90.1	28.6	32.8	47.2	57.7
1902–1907	56.6	72.4	49.3	71.4	44.0	66.5	80.4	82.3
South Atlantic:								
1902–1912	102.8	148.4	256.1	278.8	73.9	130.3	120.7	132.3
1907–1912	32.7	36.6	115.4	87.2	21.3	33.8	33.8	23.0
1902–1907	52.9	81.9	65.3	102.3	43.4	72.2	65.0	88.9
East South Central:								
1902–1912	148.0	193.2	319.4	331.2	106.1	166.8	186.2	187.2
1907–1912	35.2	41.5	102.1	106.9	13.2	22.7	57.0	48.0
1902–1907	83.5	107.2	107.5	108.3	82.1	117.5	82.3	94.1
West South Central:								
1902–1912	184.4	201.6	436.4	356.5	151.2	183.2	205.2	184.4
1907–1912	37.2	50.7	141.1	131.2	24.4	48.6	42.3	30.8
1902–1907	107.3	100.2	121.5	97.5	101.9	90.6	114.6	117.5
Mountain:								
1902–1912	188.3	222.3	379.6	381.5	119.7	149.1	268.6	302.0
1907–1912	49.9	53.1	71.5	67.1	23.7	36.0	83.5	71.7
1902–1907	92.4	110.4	179.6	188.1	77.6	83.3	100.9	134.2
Pacific:								
1902–1912	236.0	266.4	710.0	618.4	148.4	212.7	328.5	264.9
1907–1912	46.1	42.3	125.9	125.4	40.5	44.4	37.4	18.9
1902–1907	130.1	157.5	258.6	218.8	76.8	116.6	211.8	207.0

The Pacific division had the largest percentages of increase for the decade, followed by the Mountain and West South Central; but for the period 1907–1912 the Mountain division had the highest rates of increase, and for the period 1902–1907 the Pacific division. As a rule, the percentages of increase for salaries and wages range higher than for the corresponding numbers of employees, whether they be of the salaried or of the wage-earning class, showing a general rise in salaries and wages. The few exceptions to the rule are undoubtedly due to differences in methods of reporting certain classes of employees at different censuses.

The number of employees is, in a general way, a measure of the size of a company. Table 143 shows the average numbers per company for the several geographic divisions, for 1912, 1907, and 1902.

Table 143

DIVISION.	AVERAGE NUMBER OF EMPLOYEES PER COMPANY.		
	1912	1907	1902
United States	290	236	177
New England	376	239	152
Middle Atlantic	381	322	253
East North Central	301	232	169
West North Central	246	204	164
South Atlantic	187	150	131
East South Central	208	173	111
West South Central	106	122	92
Mountain	112	107	87
Pacific	409	267	152

The average for the United States as a whole was 290 in 1912, as compared with 236 in 1907 and 177 in 1902; the percentages of increase for 1902–1912, 1907–1912, and 1902–1907, respectively, being 63.8, 22.9, and 33.3.

The Pacific division led in average size, measured by number of employees, in 1912, followed by the Middle Atlantic and New England divisions; but in 1907 and 1902 the Middle Atlantic division was in the lead, followed by the Pacific division in 1907 and the East North Central division in 1902.

Table 166 (p. 324) gives the number and salaries and wages for each of the several classes of employees, as called for in the schedule used in 1912, by geographic divisions and states.

The six ranking states in number of employees were New York, Pennsylvania, Illinois, Massachusetts, Ohio, and California.

Employee and wage statistics of operating companies, by classified groups.—The ratios of the number of employees to miles of track, car-mileage, and number of revenue passengers carried depend upon various conditions, and the ratios for diverse company groups develop some features that may be of interest. Table 144 presents employee, wage, and ratio statistics for the several classified groups, heretofore considered, namely, companies classified according to income from railway operations, as elevated and subway and surface companies, and as companies without and with commercial lighting.

EMPLOYEES AND WAGE STATISTICS OF OPERATING COMPANIES, BY CLASSIFIED GROUPS: 1912, 1907, AND 1902.

Table 144

	Census.	Total.	COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS.			Without commercial lighting.	With commercial lighting.	Elevated and subway.	Surface.
			Class A. $1,000,000 and over.	Class B. $250,000 but less than $1,000,000.	Class C. Less than $250,000.				
Number of companies	1912	975	91	155	729	760	168	7	968
	1907	939	76	130	733	709	175	6	933
	1902	797	44	81	672	628	112	......	......
Miles of track	1912	41,064.82	21,305.99	9,652.09	10,106.74	31,883.35	8,825.14	517.81	40,547.01
	1907	34,088.56	15,402.09	8,341.81	10,344.66	26,404.75	6,883.65	420.40	33,668.16
	1902	22,159.96	8,414.31	4,808.47	8,937.18	18,868.43	2,460.36	......	......
Revenue car-mileage	1912	1,921,620,074	1,433,660,031	281,591,761	206,428,282	1,646,536,325	271,258,161	219,467,272	1,702,152,802
	1907	1,610,290,340	1,131,741,588	259,873,472	218,675,280	1,381,402,281	223,608,250	143,634,475	1,466,655,865
	1902	1,129,614,074	731,882,858	187,399,911	210,331,305	1,031,551,090	85,042,936	......	......
Revenue passengers	1912	9,545,554,667	7,635,471,119	1,148,582,234	761,501,314	8,341,549,514	1,190,829,824	991,062,330	8,554,492,337
	1907	7,422,266,331	5,622,329,267	1,022,955,987	776,981,077	6,497,189,567	912,807,187	635,653,072	6,786,613,259
	1902	4,723,902,759	3,357,796,250	711,500,132	654,606,377	4,380,330,656	305,833,612	......	......
Salaried employees: Number	1912	23,271	14,926	4,311	4,034	17,380	5,755	907	22,364
	1907	11,700	6,641	2,155	2,904	8,941	2,619	362	11,338
	1902	7,128	3,731	1,070	2,327	5,954	990	......	......
Per 10 miles of track	1912	5.67	7.01	4.47	3.99	5.45	6.52	17.52	5.52
	1907	3.43	4.31	2.58	2.81	3.39	3.80	8.61	3.37
	1902	3.22	4.43	2.23	2.60	3.16	4.02	......	......
Per 1,000,000 car-miles	1912	12.11	10.41	15.31	19.54	10.56	21.24	4.13	13.14
	1907	7.27	5.87	8.29	13.28	6.47	11.71	2.52	7.73
	1902	6.31	5.10	5.71	11.06	5.77	11.64	......	......
Per 1,000,000 revenue passengers	1912	2.44	1.95	3.76	5.30	2.08	4.84	0.92	2.61
	1907	1.58	1.18	2.11	3.74	1.38	2.87	0.57	1.67
	1902	1.51	1.11	1.50	3.55	1.36	3.24	......	......
Salaries	1912	$26,128,786	$17,911,322	$4,527,872	$3,689,592	$20,068,510	$5,980,176	$1,397,898	$24,730,888
	1907	12,909,466	7,802,168	2,461,344	2,645,954	10,053,426	2,789,382	569,317	12,340,149
	1902	7,439,716	4,152,141	1,287,109	2,000,466	6,320,132	998,460	......	......
Ratio of salaries to operating expenses (per cent).	1912	7.8	7.5	8.5	9.2	7.3	10.2	5.8	8.0
	1907	5.1	4.5	6.0	7.2	4.8	6.7	3.8	5.2
	1902	5.2	4.5	5.5	7.4	4.9	7.8	......	......
Ratio of salaries to operating revenues (per cent).	1912	4.6	4.2	5.2	6.3	4.3	5.7	2.7	4.8
	1907	3.1	2.6	3.7	4.9	2.9	4.0	1.7	3.2
	1902	3.0	2.5	3.2	5.0	2.8	4.5	......	......
Wage earners: Average number	1912	259,190	190,200	40,233	28,757	215,858	42,617	19,098	240,092
	1907	209,729	150,321	31,510	27,898	175,385	33,187	12,501	197,228
	1902	133,641	86,814	23,226	23,601	119,261	12,498	......	......
Per 10 miles of track	1912	63	89	42	28	68	48	369	59
	1907	62	98	38	27	66	48	297	59
	1902	60	103	48	26	63	51	......	......
Per 1,000,000 car-miles	1912	135	133	143	139	131	157	87	141
	1907	130	133	121	128	127	148	87	134
	1902	118	119	124	112	116	147	......	......
Per 1,000,000 revenue passengers	1912	27	25	35	38	26	36	19	28
	1907	28	27	31	36	27	36	20	29
	1902	28	26	33	36	27	41	......	......
Wages	1912	$174,762,153	$131,765,049	$26,087,790	$16,909,314	$147,543,971	$26,947,564	$13,866,813	$160,895,340
	1907	138,081,633	101,436,272	20,467,959	16,177,402	117,178,850	20,526,304	8,588,493	129,493,140
	1902	80,770,449	54,764,832	13,264,451	12,741,166	73,330,581	6,741,201	......	......
Ratio of wages to operating expenses (per cent).	1912	52.5	55.0	49.0	42.4	53.9	46.0	58.7	52.0
	1907	54.9	58.5	49.5	44.2	56.1	49.4	56.8	54.8
	1902	56.8	59.6	56.8	47.0	57.3	52.5	......	......
Ratio of wages to operating revenues (per cent).	1912	30.8	31.2	30.2	28.9	31.9	25.8	26.5	31.2
	1907	33.0	34.1	30.6	29.8	33.7	29.8	25.4	33.7
	1902	32.7	32.6	33.4	31.8	32.9	30.5	......	......
Conductors and motormen: Average number	1912	131,321	97,739	19,307	14,275	110,582	20,360	[1] 3,831	127,490
	1907	115,518	83,907	16,741	14,870	98,505	16,435	[2] 4,582	110,936
	1902	80,144	52,178	13,836	14,130	72,681	6,325	......	......
Per 10 miles of track	1912	32	46	20	14	35	23	126	31
	1907	34	54	20	14	37	24	109	33
	1902	36	62	29	16	39	26	......	......
Per 1,000,000 car-miles	1912	68	68	69	69	67	75	30	75
	1907	72	74	64	68	71	73	32	76
	1902	71	71	74	67	70	74	......	......
Per 1,000,000 revenue passengers	1912	14	13	17	19	13	17	7	15
	1907	16	15	16	19	15	18	7	16
	1902	17	16	19	22	17	21	......	......
Wages	1912	$95,451,625	$72,979,444	$13,391,743	$9,080,438	$81,975,657	$13,308,953	$3,473,008	$91,978,617
	1907	75,705,054	56,032,821	11,029,078	8,643,155	65,499,612	10,032,756	3,172,746	72,532,308
	1902	48,642,359	33,257,227	7,819,147	7,565,985	45,004,476	3,225,960	......	......
Ratio of wages to operating expenses (per cent).	1912	28.7	30.4	25.1	22.8	30.0	22.7	14.7	29.7
	1907	30.1	32.3	26.7	23.6	31.4	24.1	21.0	30.7
	1902	34.2	36.2	33.5	27.9	35.1	25.1	......	......
Ratio of wages to operating revenues (per cent).	1912	16.8	17.3	15.5	15.5	17.7	12.7	6.6	17.9
	1907	18.1	18.9	16.5	15.9	18.8	14.5	9.4	18.9
	1902	19.6	19.8	19.7	18.9	20.2	14.6	......	......

[1] Exclusive of 2,676 guards on New York subway trains, who are included under "All other employees." For comparative purposes these guards are included with conductors and motormen in computing the ratios.

[2] Includes guards on New York subway trains.

EMPLOYEES AND WAGE STATISTICS OF OPERATING COMPANIES, BY CLASSIFIED GROUPS: 1912, 1907, AND 1902—Continued.

Table 144—Continued.

	Census.	Total.	COMPANIES CLASSIFIED ACCORDING TO INCOME FROM RAILWAY OPERATIONS.			Without commercial lighting.	With commercial lighting.	Elevated and subway.	Surface.
			Class A. $1,000,000 and over.	Class B. $250,000 but less than $1,000,000.	Class C. Less than $250,000.				
Wage earners—Continued.									
All other employees—									
Average number	1912	127,869	92,461	20,926	14,482	105,276	22,257	5,267	112,602
	1907	94,211	66,414	14,769	13,028	76,880	16,752	7,919	86,292
	1902	53,497	34,636	9,390	9,471	46,580	6,173	......	......
Per 10 miles of track	1912	3'	43	22	14	33	25	243	28
	1907	28	43	18	13	29	24	188	26
	1902	24	41	20	11	25	25	......	......
Per 1,000,000 car-miles	1912	67	64	74	70	64	82	57	66
	1907	59	59	57	60	56	75	55	59
	1902	47	47	50	45	45	73	......	......
Per 1,000,000 revenue passengers	1912	13	12	18	19	13	19	13	13
	1907	13	12	14	17	12	18	12	13
	1902	11	10	13	14	11	20	......	......
Wages	1912	$79,310,528	$58,785,605	$12,696,047	$7,828,876	$65,568,314	$13,638,611	$10,393,805	$68,916,723
	1907	62,376,579	45,403,451	9,438,881	7,534,247	51,679,238	10,493,548	5,415,747	56,960,832
	1902	32,128,090	21,507,605	5,445,304	5,175,181	28,326,105	3,515,241	......	......
Ratio of wages to operating expenses (per cent).	1912	23.8	24.5	23.8	19.6	24.0	23.3	44.0	22.4
	1907	24.8	26.2	22.8	20.6	24.7	25.2	35.8	24.1
	1902	22.6	23.4	23.3	19.1	22.1	27.4	......	......
Ratio of wages to operating revenues (per cent).	1912	14.0	13.9	14.7	13.4	14.2	13.0	19.9	13.4
	1907	14.9	15.3	14.1	13.9	14.8	15.2	16.0	14.8
	1902	13.0	12.8	13.7	12.9	12.7	15.9	......	......

For all operating companies combined there was an increase in the number of salaried employees and wage earners in 1912 as compared with 1907, and in 1907 as compared with 1902, for each unit of measurement, except in the case of wage earners per revenue passengers carried, where a slight drop is shown from 1902 to 1912. Similar increases appear, as a rule, in the case of salaried employees of each group of companies. A certain number of salaried officials and clerks are necessary for the maintenance of a corporate organization, but the number does not increase at the same rate as the volume of business done per unit of track; for the companies of class A, handling approximately 3,600,000 revenue passengers per 10 miles of track, averaged seven salaried employees for that trackage unit, while companies of class B, with an average of 4.5 salaried employees, handled but 1,190,000 revenue passengers, and companies of class C, with 4 salaried employees, 753,000 revenue passengers. Wage earners are more intimately allied to track and traffic than are salaried employees, and the number of wage earners on a track basis is necessarily greater for the larger companies. The reverse is true when the number of wage earners is compared with the number of revenue passengers, and the changes in ratios from census to census are most marked for the larger companies.

Relation of salaries and wages to operating expenses and operating revenues.—The causes affecting the general operating ratio (see p. 261) are applicable to the ratio of salaries and wages to operating expenses, which for all classes of companies was 60.3 per cent in 1912, a shade higher than in 1907 but lower than in 1902. Table 145 assembles the ratios of salaries and wages to operating expenses for the several groups of companies.

Table 145 RATIO OF SALARIES AND WAGES TO OPERATING EXPENSES, BY GROUPS OF COMPANIES (PER CENT).

CLASSIFICATION GROUP.	Total.			Salaries.			Wages.		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Total—All companies	60.3	60.1	62.1	7.8	5.1	5.2	52.5	54.9	56.8
Companies classified according to income from railway operations:									
Class A—$1,000,000 and over	62.5	63.0	64.2	7.5	4.5	4.5	55.0	58.5	59.6
Class B—$250,000 but less than $1,000,000	57.5	55.5	62.3	8.5	6.0	5.5	49.0	49.5	56.8
Class C—Less than $250,000	51.6	51.4	54.4	9.2	7.2	7.4	42.4	44.2	47.0
Companies without commercial lighting	61.2	60.9	62.2	7.3	4.8	4.9	53.9	56.1	57.3
Companies with commercial lighting	56.2	56.1	60.3	10.2	6.7	7.8	46.0	49.4	52.5
Elevated and subway railways	64.6	60.6	......	5.8	3.8	......	58.7	56.8	......
Surface railways	60.0	60.0	......	8.0	5.2	......	52.0	54.8	......

The ratios for salaries and wages combined increase uniformly from class C to class A—that is, from the smaller to the larger groups. This is the reverse of the movement of operating ratios, which range high for the small companies and low for the large companies. When salaries and wages are considered separately, however, it will be seen that the ratios of salaries to operating expenses decrease steadily as the companies grow larger, while the ratios for wages increase; for consolidation into larger companies and expansion of operations tend to reduce the proportionate number of salaried employees, while the large companies operating in the more densely populated districts require comparatively larger forces of workmen and correspondingly greater outlays in wages.

The ratios of salaries and wages combined and of wages alone to total operating expenses are lower for railway companies that do commercial lighting than for those without commercial light and power service, while the salary ratio is higher; consequently the expenses incident to electric light service are factors tending to reduce the ratios of wages to total operating expenses for the smaller companies, among which are found most of the companies with commercial light and power service.

Table 146 shows the ratios of total salaries and wages to operating expenses, by states, for the three census years, arranged in the order of the ratios for 1912. There is a wide range in these ratios, and conditions affecting them are so varying that a comparison by states should be made with caution.

Table 146

STATE.	RATIO OF SALARIES AND WAGES COMBINED TO OPERATING EXPENSES (PER CENT).[1]		
	1912	1907	1902
United States	60.3	60.1	62.1
Oregon	68.0	65.2	67.0
District of Columbia	65.4	62.4	65.0
Utah	65.1	60.8	*59.6*
Maine	65.0	*58.7*	*51.7*
Minnesota	64.3	*58.7*	63.4
Colorado	64.0	68.6	63.2
Tennessee	63.3	*55.5*	*55.5*
Wisconsin	63.1	61.2	72.5
Connecticut	63.0	65.2	*60.7*
Massachusetts	63.0	60.9	*60.3*
Pennsylvania	63.0	60.5	64.7
Illinois	62.9	*58.1*	*56.3*
Maryland	62.7	66.3	66.8
Iowa	62.6	*55.3*	*60.8*
West Virginia	62.4	*54.5*	*61.0*
Louisiana	61.5	62.2	66.4
California	61.4	64.0	74.2
Montana	61.2	*58.4*	*53.0*
Oklahoma	61.2	*52.2*	....
South Dakota	61.1	77.9	....
New York	60.7	63.7	62.1
North Dakota	60.6	*58.1*	....
Kentucky	60.2	*51.6*	*48.2*
Nevada	*59.8*	*36.5*	....
Rhode Island	*59.6*	68.9	*60.4*
Indiana	*59.6*	*56.4*	66.3
Ohio	*59.1*	*56.0*	65.9
Delaware	*58.5*	*52.4*	*49.3*
New Jersey	*57.9*	*54.0*	*60.6*
Nebraska	*57.3*	66.7	*57.6*
Michigan	*56.6*	63.4	*62.0*
Idaho	*56.0*	*53.8*	80.2
Missouri	*55.3*	60.3	62.1
Alabama	*54.9*	*45.8*	62.2
North Carolina	*54.7*	*47.4*	*49.0*
Georgia	*53.8*	*53.5*	69.6
Arkansas	*53.2*	*57.3*	*60.5*
Virginia	*52.7*	*49.5*	*49.7*
Florida	*52.5*	*53.6*	*59.7*
Washington	*52.2*	65.5	64.0
Kansas	*51.8*	*59.9*	65.6
New Hampshire	*51.8*	*43.6*	*46.9*
Vermont	*50.9*	*49.9*	*55.5*
New Mexico	*50.4*	*50.0*	*57.3*
Texas	*50.2*	*50.0*	*60.0*
South Carolina	*47.7*	*45.0*	*44.9*
Mississippi	*46.4*	*49.8*	*46.8*
Wyoming	*41.0*	....	....
Arizona	*38.8*	*49.1*	*50.8*

[1] Italics indicate ratios below the average for the United States.

Table 147 shows the ratios of salaries and wages to operating revenues, by groups of companies classified according to income and as elevated and subway, and surface railways, for 1912, 1907, and 1902.

Table 147

CLASSIFICATION GROUP.	RATIOS OF SALARIES AND WAGES TO OPERATING REVENUES, BY GROUPS OF COMPANIES (PER CENT).								
	Total.			Salaries.			Wages.		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Total—All companies	35.4	36.1	35.7	4.6	3.1	3.0	30.8	33.0	32.7
Companies classified according to income from railway operations:									
Class A—$1,000,000 and over	35.4	36.8	35.1	4.2	2.6	2.5	31.2	34.1	32.6
Class B—$250,000 but less than $1,000,000	35.4	34.3	36.6	5.2	3.7	3.2	30.2	30.6	33.4
Class C—Less than $250,000	35.2	34.7	36.8	6.3	4.9	5.0	28.9	29.8	31.8
Companies without commercial lighting	36.2	36.6	35.8	4.3	2.9	2.8	31.9	33.7	32.9
Companies with commercial lighting	31.5	33.8	35.0	5.7	4.0	4.5	25.8	29.8	30.5
Elevated and subway railways	29.2	27.0	....	2.7	1.7	....	26.5	25.4	....
Surface railways	36.0	36.9	....	4.8	3.2	....	31.2	33.7	....

CHAPTER IX.

SALE OF CURRENT BY ELECTRIC-RAILWAY COMPANIES.

The growth of electric railways since the census of 1902 has been accompanied by a large increase in the sale of current to other roads or to the general public for light, power, or other purposes. There were 425 railway companies in 1912 which sold current, including (*a*) 44 companies operating electric light and power departments for which reports separate and distinct from those relating to the railway operations could be made; (*b*) 169 companies operating electric light and power departments more or less closely affiliated with the railway departments and for which separate reports covering capitalization, operating expenses, etc., could not be made; and (*c*) 212 companies that sold current to affiliated companies or connecting lines or incidentally to the public. The light and power departments of the first class (*a*) are treated as central electric light and power stations, and the statistics relating thereto are included in the report for that branch of the electrical industries. The statistics bearing upon the lamp installations of the light and power departments not separable from railway operations are given in the report on Central Electric Light and Power Stations (p. 56), and need not be duplicated here. The income statistics for these departments are also given in the report on Central Electric Light and Power Stations (p.18), in order to show the total income from electric light and power service.

Table 148 shows the revenue derived from sale of current and the income of electric light and power departments, by class of service, for 1912, 1907, and 1902.

Table 148 REVENUE FROM SALE OF CURRENT AND INCOME OF ELECTRIC LIGHT AND POWER DEPARTMENTS, BY CLASS OF SERVICE: 1912, 1907, AND 1902.

CLASS OF SERVICE.	1912	1907	1902	Per cent of increase.[1]		
				1902–1912	1907–1912	1902–1907
Revenue from sale of current for light and power	$36,500,030	$20,093,302	$7,703,574	373.8	81.7	160.8
Companies with light and power departments	$30,984,555	$16,576,555	$6,271,815	394.0	86.9	164.3
Other companies	$5,515,475	$3,516,747	$1,431,759	285.2	56.8	145.6
COMPANIES WITH LIGHT AND POWER DEPARTMENTS.						
Number	169	177	118	43.2	−4.5	50.0
Income of light and power departments	$31,515,582	$17,291,824	$6,469,726	387.1	82.3	167.3
Electric service	30,984,555	16,576,555	6,271,815	394.0	86.9	164.3
Commercial	26,102,077	13,778,714	4,847,200	438.5	89.4	184.3
Municipal street lighting	2,682,524	2,254,957	1,417,985	89.2	19.0	59.0
Municipal building lighting	134,894	(2)	(2)	....	....	....
Sale of electric current to other public-service corporations	2,065,060	542,884	6,630	....	280.4	....
Profit on merchandise sales	140,820	240,704	(2)	....	−41.5	....
Income of light and power departments from other sources	390,207	474,565	197,911	97.2	−17.8	139.8
Estimated value of free service furnished municipalities (not included under income)	65,951	33,697	(2)	....	95.7	....

[1] A minus sign (−) denotes decrease.

[2] Figures not available.

The income from current furnished for commercial service constituted 82.8 per cent of the income of the light and power departments in 1912, as compared with 79.7 per cent in 1907 and 74.9 per cent in 1902.

The ratio of increase for the decade 1902–1912 in revenue from sale of current (373.8 per cent) was considerably higher than the ratio of increase for transportation revenues (120.4 per cent), the revenues from the sale of current constituting 6.6 per cent of the combined transportation revenues and revenues from sale of current in 1912, as compared with 4.9 per cent in 1907 and 3.2 per cent in 1902.

The distribution of the electric light and power departments of electric railways, by states, in 1912, 1907, and 1902, is shown in Table 149.

Table 149

DIVISION AND STATE.	ELECTRIC RAILWAYS WITH ELECTRIC LIGHT AND POWER DEPARTMENTS.		
	1912	1907	1902
UNITED STATES	169	177	118
GEOGRAPHIC DIVISIONS:			
New England	6	6	6
Middle Atlantic	12	18	12
East North Central	49	53	32
West North Central	22	20	14
South Atlantic	35	41	30
East South Central	14	16	11
West South Central	14	11	3
Mountain	7	5	3
Pacific	10	7	7
NEW ENGLAND:			
Maine	4	3	3
New Hampshire	......	1	1
Vermont	1	......	......
Massachusetts	1	1	......
Connecticut	......	1	2
MIDDLE ATLANTIC:			
New York	8	11	10
New Jersey	......	......	2
Pennsylvania	4	7	......
EAST NORTH CENTRAL:			
Ohio	21	20	11
Indiana	8	7	2
Illinois	10	12	4
Michigan	6	7	6
Wisconsin	4	7	9
WEST NORTH CENTRAL:			
Minnesota	1	1	1
Iowa	12	11	8
Missouri	3	4	3
Nebraska	1	1	1
Kansas	5	3	1
SOUTH ATLANTIC:			
Delaware	1	......	1
Maryland	1	1	1
Virginia	7	10	7
West Virginia	5	7	3
North Carolina	6	8	5
South Carolina	2	3	3
Georgia	9	7	7
Florida	4	5	3
EAST SOUTH CENTRAL:			
Kentucky	......	2	2
Tennessee	4	3	2
Alabama	6	5	4
Mississippi	4	6	3
WEST SOUTH CENTRAL:			
Arkansas	5	5	2
Louisiana	3	2	1
Oklahoma	2	......	......
Texas	4	4	......
MOUNTAIN:			
Montana	2	1	1
Colorado	3	2	2
Utah	1	1	......
New Mexico	......	1	......
Arizona	1	......	......
PACIFIC:			
Washington	9	6	4
Oregon	1	......	1
California	......	1	2

The distribution of the revenue from sale of current for the three years, by geographic divisions and states, is given in Table 161 (p. 308).

Table 150 gives the statistics pertaining to revenue from sale of current and to income, by detailed accounts and by geographic divisions, for 1912.

Table 150

REVENUE FROM SALE OF CURRENT AND INCOME OF ELECTRIC LIGHT AND POWER DEPARTMENTS, BY GEOGRAPHIC DIVISIONS: 1912.

DIVISION.	Revenue from sale of electric current for light or power—All companies.	Revenue from sale of current by companies without light and power departments.	Electric railways operating electric light and power departments.									
			Number of operating companies.	Income of light and power departments.								Estimated value of free service furnished municipalities (not included under income).
				Aggregate.	Electric service.					Profit on merchandise sales.	Income of these departments from other sources.	
					Total.	Commercial.	Municipal street lighting.	Municipal building lighting.	Sale of electric current to other public-service corporations.			
United States	$36,500,030	$5,515,475	169	$31,515,582	$30,984,555	$26,102,077	$2,682,524	$134,894	$2,065,060	$140,820	$390,207	$65,951
New England	1,384,764	339,439	6	1,074,634	1,045,325	924,134	105,029	10,205	5,957	3,093	26,216	....
Middle Atlantic	3,381,090	2,404,555	12	986,755	976,535	521,623	259,538	55,848	139,526	5,544	4,676	11,392
East North Central	8,330,213	1,250,028	49	7,233,153	7,080,285	5,413,936	670,634	7,241	988,474	48,897	103,971	13,560
West North Central	2,233,356	610,091	22	1,740,740	1,623,265	1,437,585	174,029	6,911	4,740	9,862	107,613	8,018
South Atlantic	7,089,358	264,066	35	6,901,540	6,825,292	5,931,476	686,015	33,447	174,354	36,049	40,199	5,354
East South Central	2,766,420	106,048	14	2,664,354	2,660,372	2,428,230	207,647	840	23,655	2,198	1,784	3,150
West South Central	1,860,737	400,622	14	1,480,764	1,460,115	1,297,846	108,824	5,069	48,376	4,766	15,883	1,983
Mountain	2,628,273	61,381	7	2,616,307	2,566,892	2,330,949	155,336	11,149	69,458	16,408	33,007	22,494
Pacific	6,825,719	79,245	10	6,817,335	6,746,474	5,816,298	315,472	4,184	610,520	14,003	56,858	....

TITLES OF GENERAL TABLES.

The general tables listed below contain the fundamental data obtained at the 1912 census of street and electric railways. These data relate to primary power, electric generating and subsidiary equipment, track mileage, rolling stock, traffic, track and capitalization, income, operating revenues, operating expenses, assets and liabilities, employees, and salaries and wages.

Table 151.—Primary power, by geographic divisions and states: 1912 (p. 278).

Table 152.—Electric generating and subsidiary equipment and current generated and purchased, by geographic divisions and states: 1912 (p. 280).

Table 153.—Track mileage, by geographic divisions and states: 1912, 1907, and 1902 (p. 282).

Table 154.—Rolling stock—cars (number and kind) and electric locomotives, by geographic divisions and states: 1912, 1907, and 1902 (p. 288).

Table 155.—Rolling stock—cars (number, kind, and equipment in detail) and electric locomotives, by geographic divisions and states: 1912 (p. 290).

Table 156.—Traffic statistics—passengers, car mileage, and car hours, by geographic divisions and states: 1912, 1907, and 1902 (p. 292).

Table 157.—Track and capitalization, by geographic divisions and states: 1912, 1907, and 1902 (p. 299).

Table 158.—Condensed income account of operating companies, by geographic divisions and states: 1912, 1907, and 1902 (p. 302).

Table 159.—Income account of nonoperating or lessor companies, by states: 1912, 1907, and 1902 (p. 305).

Table 160.—Condensed income account of operating and lessor companies combined, by states: 1912, 1907, and 1902 (p. 306).

Table 161.—Operating revenues, by geographic divisions and states: 1912, 1907, and 1902 (p. 308).

Table 162.—Operating expenses, by accounts, by geographic divisions and states: 1912, 1907, and 1902 (p. 311).

Table 163.—Operating expenses, by detailed accounts, by geographic divisions and states: 1912 (p. 314).

Table 164.—Condensed balance sheet of operating and lessor companies combined, by geographic divisions and states: 1912, 1907, and 1902 (p. 318).

Table 165.—Balance sheet of operating and lessor companies combined, by geographic divisions and states: 1912 (p. 322).

Table 166.—Employees, salaries, and wages of operating companies, by classes of occupation, by geographic divisions and states: 1912 (p. 324).

Table 151.—PRIMARY POWER, BY

	DIVISION AND STATE.	Number of operating companies.	Number of companies with power plant equipment.	Aggregate horsepower.	STEAM POWER.															
					Total		Steam engines.										Steam turbines.			
					Number of units.	Horsepower.	Total.		500 horsepower or under.		Over 500 horsepower and under 2,000 horsepower.		2,000 horsepower and under 5,000 horsepower.		5,000 horsepower and over.		Total.		500 horsepower or under.	
							No.	H. P.	No.	H. P.	No.	H. P.	No.	H. P.	No.	H. P.	No.	H. P.	No.	H. P.
1	UNITED STATES...	975	495	[1]3,665,051	2,264	3,169,554	1,802	1,706,754	892	264,628	704	697,017	167	432,859	39	312,250	462	1,462,800	33	8,264
	GEOGRAPHIC DIVISIONS:																			
2	New England........	91	55	421,888	325	384,178	293	243,246	163	54,201	109	119,645	21	69,400	...	...	32	140,932	1	125
3	Middle Atlantic......	246	127	977,703	542	951,088	448	592,609	212	59,018	157	140,341	43	101,000	36	292,250	94	358,479	5	1,835
4	East North Central..	222	127	824,707	602	778,194	486	436,882	180	55,450	254	254,788	52	126,644	...	...	116	341,312	4	1,370
5	West North Central..	85	48	327,470	185	301,895	146	116,787	86	19,845	44	46,942	15	45,000	1	5,000	39	185,108	4	1,100
6	South Atlantic.......	107	56	382,924	282	313,400	201	133,942	131	41,281	58	50,661	10	27,000	2	15,000	81	179,458	9	1,398
7	East South Central...	45	22	138,607	93	138,607	59	59,897	24	7,412	23	23,610	12	28,875	...	...	34	78,710	4	1,385
8	West South Central..	79	32	111,236	110	110,561	81	50,437	52	14,691	25	25,456	4	10,290	...	...	29	60,124	4	705
9	Mountain............	40	11	91,938	38	70,868	22	20,874	6	2,350	14	13,374	2	5,150	...	...	16	49,994	...	...
10	Pacific.............	60	17	388,578	87	120,763	66	52,080	38	10,380	20	22,200	8	19,500	...	...	21	68,683	2	346
	NEW ENGLAND:																			
11	Maine...............	16	9	40,090	31	14,526	29	13,226	23	7,126	5	3,800	1	2,300	...	...	2	1,300	...	...
12	New Hampshire.....	13	5	4,102	8	1,920	8	1,920	8	1,920	...	...	...	...	...	...	...	...	...	...
13	Vermont............	9	7	7,655	14	3,000	14	3,000	13	2,400	1	600	...	...	...	...	...	...	...	...
14	Massachusetts.......	43	27	272,796	197	268,387	177	165,005	95	33,680	66	76,225	16	55,100	...	...	20	103,382	1	125
15	Rhode Island........	2	1	44,850	19	44,850	16	20,350	5	1,500	7	6,850	4	12,000	...	...	3	24,500	...	...
16	Connecticut.........	8	6	52,395	56	51,495	49	39,745	19	7,575	30	32,170	...	...	...	...	7	11,750	...	...
	MIDDLE ATLANTIC:																			
17	New York...........	101	48	655,720	228	634,490	195	422,915	79	20,490	55	50,125	25	60,050	36	292,250	33	211,575	...	...
18	New Jersey..........	24	16	29,098	45	29,098	35	17,941	19	6,775	16	11,166	...	...	...	...	10	11,157	1	335
19	Pennsylvania........	121	63	292,885	269	287,500	218	151,753	114	31,753	86	79,050	18	40,950	...	...	51	135,747	4	1,500
	EAST NORTH CENTRAL:																			
20	Ohio................	75	52	333,075	281	330,995	227	176,148	88	28,295	127	117,253	12	30,600	...	...	54	154,847	2	804
21	Indiana.............	34	21	121,920	94	121,580	62	47,310	24	5,600	37	39,710	1	2,000	...	...	32	74,270	...	...
22	Illinois.............	67	27	174,780	115	169,580	101	137,002	20	6,350	55	65,552	26	65,100	...	...	14	32,578	2	566
23	Michigan............	22	14	68,280	70	58,905	64	45,055	36	11,705	24	23,350	4	10,000	...	...	6	13,850	...	...
24	Wisconsin...........	24	13	126,652	42	97,134	32	31,367	12	3,500	11	8,923	9	18,944	...	...	10	65,767	...	...
	WEST NORTH CENTRAL:																			
25	Minnesota...........	9	4	113,583	15	91,583	7	8,250	4	1,150	2	2,100	...	...	1	5,000	8	83,333	...	...
26	Iowa................	24	17	56,462	66	56,462	46	23,662	31	7,245	13	11,417	2	5,000	...	...	20	32,800	3	600
27	Missouri............	19	13	125,940	70	125,940	66	70,540	34	5,840	19	24,700	13	40,000	...	...	4	55,400	...	...
28	North Dakota........	3	1	80	1	80	1	80	1	80	...	...	...	...	...	...	...	...	...	...
29	South Dakota........	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
30	Nebraska............	7	2	19,125	12	19,125	7	6,950	2	775	5	6,175	...	...	...	...	5	12,175	...	...
31	Kansas..............	21	11	12,280	21	8,705	19	7,305	14	4,755	5	2,550	...	...	...	...	2	1,400	1	500
	SOUTH ATLANTIC:																			
32	Delaware............	4	3	20,250	20	20,250	14	7,700	11	4,000	3	3,700	...	...	...	...	6	12,550	...	...
33	Maryland............	14	4	71,075	38	71,075	36	48,575	20	6,825	6	4,250	8	22,500	2	15,000	2	22,500	...	...
34	District of Columbia.	7	2	23,366	14	23,366	10	6,866	3	1,200	7	5,666	...	...	...	...	4	16,500	...	...
35	Virginia............	18	11	100,904	59	78,785	31	14,635	18	4,385	13	10,250	...	...	...	...	28	64,150	6	890
36	West Virginia........	21	10	25,740	44	25,740	36	17,290	23	7,040	13	10,250	...	...	...	...	8	8,450	...	...
37	North Carolina.......	13	10	28,730	29	16,930	18	5,390	17	4,640	1	750	...	...	...	...	11	11,540	2	100
38	South Carolina.......	6	3	12,110	16	12,110	13	5,370	11	3,690	2	1,680	...	...	...	...	3	6,740	...	...
39	Georgia.............	14	7	82,881	39	49,351	24	16,751	15	5,051	7	7,200	2	4,500	...	...	15	32,600	...	...
40	Florida.............	10	6	17,868	23	15,793	19	11,365	13	4,450	6	6,915	...	...	...	...	4	4,428	1	408
	EAST SOUTH CENTRAL:																			
41	Kentucky............	10	4	26,460	17	26,460	15	17,710	3	1,050	7	5,285	5	11,375	...	...	2	8,750	...	...
42	Tennessee...........	12	6	53,367	34	53,367	18	22,567	6	2,667	8	9,900	4	10,000	...	...	16	30,800	2	900
43	Alabama.............	11	7	48,930	28	48,930	18	17,720	8	2,445	7	7,775	3	7,500	...	...	10	31,210	1	35
44	Mississippi..........	12	5	9,850	14	9,850	8	1,900	7	1,250	1	650	...	...	...	...	6	7,950	1	450
	WEST SOUTH CENTRAL:																			
45	Arkansas............	10	6	16,744	19	16,744	14	9,445	8	1,945	5	5,250	1	2,250	...	...	5	7,299	...	...
46	Louisiana...........	13	8	43,745	32	43,745	27	22,875	15	5,220	9	9,615	3	8,040	...	...	5	20,870	...	...
47	Oklahoma............	17	5	9,675	10	9,375	6	3,475	4	1,550	2	1,925	...	...	...	...	4	5,900	...	...
48	Texas...............	39	13	41,072	49	40,697	34	14,642	25	5,976	9	8,666	...	...	...	...	15	26,055	4	705
	MOUNTAIN:																			
49	Montana.............	6	2	1,520	1	750	1	750	...	...	1	750	...	...	...	...	...	...	...	...
50	Colorado............	16	5	48,532	28	43,332	16	17,874	2	800	12	11,924	2	5,150	...	...	12	25,458	...	...
51	New Mexico..........	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
52	Arizona.............	4	1	600	2	600	2	600	2	600	...	...	...	...	...	...	...	...	...	...
53	Idaho...............	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
54	Wyoming............	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
55	Nevada..............	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
56	Utah................	5	3	41,286	7	26,186	3	1,650	2	950	1	700	...	...	...	...	4	24,536	...	...
	PACIFIC:																			
57	Washington	19	8	245,817	28	53,767	18	14,450	8	1,700	8	7,750	2	5,000	...	...	10	39,317	2	346
58	Oregon..............	6	2	109,450	18	33,950	12	12,450	6	2,600	5	6,350	1	3,500	...	...	6	21,500	...	...
59	California...........	35	7	33,311	41	33,046	36	25,180	24	6,080	7	8,100	5	11,000	...	...	5	7,866	...	...

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[1] Includes 46,631 horsepower of idle equipment distributed as follows: 85 steam engines of 42.225 horsepower, 1 steam turbine of 3,666 horsepower, and 5 water wheels of 740 horsepower.

GEOGRAPHIC DIVISIONS AND STATES: 1912.

STEAM POWER—continued.						GAS AND OIL ENGINES.								WATER WHEELS AND TURBINES.										
Steam turbines—Continued.																								
Over 500 horsepower and under 2,000 horsepower.		2,000 horsepower and under 5,000 horsepower.		5,000 horsepower and over.		Total.		500 horsepower or under.		Over 500 horsepower and under 2,000 horsepower.		2,000 horsepower and under 5,000 horsepower.		Total.		500 horsepower or under.		Over 500 horsepower and under 2,000 horsepower.		2,000 horsepower and under 5,000 horsepower.		5,000 horsepower and over.		
No.	H. P.	No.	H. P.	No.	H. P.	No.	H. P.	No.	H. P.	No.	H. P.	No.	H. P.	No.	H. P.	No.	H. P.	No.	H. P.	No.	H. P.	No.	H. P.	
203	218,169	145	438,422	81	797,945	48	24,190	32	8,390	13	8,800	3	7,000	383	471,307	205	52,092	119	123,015	31	82,000	28	214,200	1
14	15,400	12	38,107	5	87,300	5	2,700	3	1,500	2	1,200			52	35,010	31	7,689	15	15,321	6	12,000			2
37	37,823	27	76,037	25	242,784	21	7,375	16	3,875	5	3,500			36	19,240	27	7,170	8	10,070	1	2,000			3
62	76,623	29	88,865	21	174,449	6	4,590	4	590			2	4,000	67	41,923	44	10,266	20	19,957	2	4,500	1	7,200	4
14	13,508	11	26,000	10	144,500	8	3,575	4	1,075	4	2,500			48	22,000	40	10,000	8	12,000					5
36	33,640	31	101,520	5	42,900	6	5,275	3	675	2	1,600	1	3,000	87	64,249	46	12,382	34	35,067	7	16,800			6
14	13,325	13	45,000	3	19,000																			7
12	11,799	11	34,220	2	13,400	2	675	2	675															8
7	8,980	7	18,347	2	22,667									19	21,070	4	1,170	14	15,200	1	4,700			9
7	7,066	4	10,326	8	50,945									74	267,815	13	3,415	20	15,400	14	42,000	27	207,000	10
2	1,300													24	25,564	7	2,100	11	11,464	6	12,000			11
														2	2,182	1	455	1	1,727					12
														12	4,655	9	2,525	3	2,130					13
6	5,600	9	30,357	4	67,300	5	2,700	3	1,500	2	1,200			12	1,709	12	1,709							14
1	750	1	3,750	1	20,000																			15
5	7,750	2	4,000											2	900	2	900							16
7	7,641	8	26,100	18	177,834	10	2,715	9	2,115	1	600			31	18,515	22	6,445	8	10,070	1	2,000			17
8	8,422	1	2,400																					18
22	21,760	18	47,537	7	64,950	11	4,660	7	1,760	4	2,900			5	725	5	725							19
29	37,131	15	48,550	8	68,362	2	250	2	250					5	1,830	5	1,830							20
17	17,155	9	25,315	6	31,800	2	340	2	340															21
6	8,345	4	12,000	2	11,667									13	5,200	7	700	6	4,500					22
4	5,850	1	3,000	1	5,000									17	9,375	14	4,500	3	4,875					23
6	8,147			4	57,620	2	4,000					2	4,000	32	25,518	18	3,236	11	10,582	2	4,500	1	7,200	24
2	1,333	1	2,000	5	80,000									48	22,000	40	10,000	8	12,000					25
9	9,600	7	16,600	1	6,000																			26
		1	2,400	3	53,000																			27
																								28
																								29
2	1,675	2	5,000	1	5,500																			30
1	900					8	3,575	4	1,075	4	2,500													31
4	2,800	1	2,250	1	7,500																			32
				2	22,500																			33
		3	9,000	1	7,500																			34
7	7,340	15	55,920											29	22,119	14	4,107	15	18,012					35
8	8,450																							36
7	5,290	2	6,150			2	1,600			2	1,600			24	10,200	21	6,000	3	4,200					37
1	1,340	2	5,400																					38
7	6,400	7	20,800	1	5,400	1	3,000					1	3,000	26	30,530	3	875	16	12,855	7	16,800			39
2	2,020	1	2,000			3	675	3	675					8	1,400	8	1,400							40
		2	8,750																					41
7	6,900	7	23,000																					42
4	4,175	2	8,000	3	19,000																			43
3	2,250	2	5,250																					44
4	3,999	1	3,300																					45
		4	14,170	1	6,700																			46
3	2,550	1	3,350			1	300	1	300															47
5	5,250	5	13,400	1	6,700	1	375	1	375															48
														3	770	3	770							49
5	7,111	7	18,347											5	5,200	1	400	4	4,800					50
																								51
																								52
																								53
																								54
																								55
2	1,869			2	22,667									11	15,100			10	10,400	1	4,700			56
3	2,866	1	2,660	4	33,445									43	192,050	9	2,850	4	4,200	14	42,000	16	143,000	57
		2	4,000	4	17,500									28	75,500	1	300	16	11,200			11	64,000	58
4	4,200	1	3,666											3	265	3	265							59

TABLE 152.—ELECTRIC GENERATING AND SUBSIDIARY EQUIPMENT AND CURRENT GENERATED AND PURCHASED, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

DIVISION AND STATE.	GENERATING EQUIPMENT—NUMBER AND KILOWATT CAPACITY OF DYNAMOS.						SUBSIDIARY EQUIPMENT.								CURRENT GENERATED AND PURCHASED—KILOWATT HOURS.		
	Total.		Direct current.		Alternating and polyphase current.		Rotary converters and motor-generator sets.		Boosters.		Transformers.		Auxiliary generators.		Output of station—current generated.	Current purchased.	Total generated and purchased.[1]
	No.	Kilowatt capacity.	No.	Kilowatt capacity.	No.	Kilowatt capacity.	No.	Kilowatt capacity.	No.	Kilowatt capacity.	No.	Kilowatt capacity.	No.	Kilowatt capacity			
UNITED STATES	2,797	[2] 2,508,066	1,642	769,875	1,155	1,738,191	2,840	1,637,260	183	24,807	8,436	2,357,397	144	12,227	6,052,690,008	2,967,318,781	9,020,017,789
GEOGRAPHIC DIVISIONS:																	
New England	436	305,739	349	170,649	87	135,090	259	123,438	29	4,332	663	185,896	14	1,620	676,541,943	95,560,776	772,102,719
Middle Atlantic	604	668,323	403	182,117	201	486,206	737	550,518	42	5,242	1,887	583,475	27	2,324	1,822,647,864	895,318,072	2,717,965,936
East North Central	706	579,840	393	210,424	313	369,416	903	442,785	46	6,524	3,545	656,908	54	4,278	1,467,194,017	796,769,999	2,263,964,046
West North Central	254	237,171	148	59,054	106	178,117	180	131,835	8	2,032	334	111,573	23	2,415	496,764,104	199,632,010	696,396,114
South Atlantic	372	269,546	175	59,557	197	209,989	246	132,410	12	1,172	624	207,070	19	1,400	394,171,487	248,907,329	643,078,816
East South Central	102	91,305	52	31,105	50	60,200	77	38,410	10	1,210	325	43,783	....	....	248,485,679	41,862,642	290,348,321
West South Central	117	84,248	54	25,407	63	58,841	82	29,360	12	2,031	100	18,815	6	65	191,355,019	53,724,320	245,079,339
Mountain	59	56,057	17	8,220	42	47,837	68	24,080	3	135	156	53,250	....	....	135,247,730	71,594,567	206,842,297
Pacific	147	215,837	51	23,342	96	192,495	288	164,424	21	2,129	802	496,627	1	125	620,291,135	563,949,066	1,184,240,201
NEW ENGLAND:																	
Maine	81	31,234	55	13,624	26	17,610	38	12,860	4	387	137	48,635	....	....	54,148,656	20,818,159	74,966,815
New Hampshire	10	2,735	8	1,535	2	1,200	15	4,218	5	680	45	6,530	1	120	5,356,050	12,198,773	17,554,823
Vermont	28	6,744	17	3,189	11	3,555	10	1,950	2	140	42	5,895	6	1,050	6,867,675	2,121,669	8,989,344
Massachusetts	227	197,504	198	115,429	29	82,075	109	61,510	8	1,470	239	80,193	7	450	452,534,898	33,085,243	485,620,141
Rhode Island	19	31,600	13	10,300	6	21,300	27	22,200	3	400	68	24,500	....	....	62,115,523	4,502,850	66,618,373
Connecticut	71	35,922	58	26,572	13	9,350	60	20,700	7	1,255	132	20,143	....	....	95,519,141	22,834,082	118,353,223
MIDDLE ATLANTIC:																	
New York	268	444,306	163	71,119	105	373,187	463	412,376	12	1,715	1,367	483,412	8	1,430	1,199,010,709	502,288,501	1,701,299,210
New Jersey	50	23,732	37	14,132	13	9,600	18	5,450	5	685	51	5,775	3	114	33,198,177	183,471,328	216,669,505
Pennsylvania	286	200,285	203	96,866	83	103,419	256	132,692	25	2,842	469	94,288	16	780	590,438,978	209,558,243	799,997,221
EAST NORTH CENTRAL:																	
Ohio	319	233,721	191	87,190	128	146,531	313	129,050	24	2,894	1,910	208,311	26	2,132	612,085,335	79,932,282	692,017,617
Indiana	101	92,947	33	12,005	68	80,942	191	62,130	....	....	588	101,069	19	814	217,967,393	59,369,623	277,337,016
Illinois	145	126,371	98	78,456	47	47,915	236	188,410	18	3,435	673	227,183	5	672	398,587,658	552,249,155	950,836,813
Michigan	78	43,746	41	18,246	37	25,500	101	29,570	....	....	201	41,610	4	660	123,724,306	95,167,503	218,891,809
Wisconsin	63	83,055	30	14,527	33	68,528	62	33,625	4	195	173	78,735	....	....	114,829,355	10,051,436	124,880,791
WEST NORTH CENTRAL:																	
Minnesota	37	79,568	14	4,068	23	75,500	41	41,985	3	700	126	50,210	1	65	89,236,100	64,132,792	153,368,892
Iowa	96	42,973	60	14,561	36	28,412	36	14,600	1	32	76	12,685	6	1,350	83,473,751	20,090,162	103,563,913
Missouri	68	92,145	41	31,340	27	60,805	69	59,800	3	1,150	93	37,953	16	1,000	267,790,944	94,203,923	361,994,867
North Dakota	1	200	1	200	.....	....	....	....	....	....	....	....	....	....	36,000	814,871	850,871
South Dakota	....	....	....	....	.....	....	2	200	....	....	....	....	....	....	....	806,380	806,380
Nebraska	12	13,425	6	4,675	6	8,750	11	8,000	1	150	9	7,575	....	....	38,869,348	790,840	39,660,188
Kansas	40	8,860	26	4,210	14	4,650	21	7,250	....	....	30	3,150	....	....	17,357,961	18,793,042	36,151,003
SOUTH ATLANTIC:																	
Delaware	19	13,200	11	4,600	8	8,600	5	3,050	....	....	....	....	....	....	22,428,459	83,801	22,512,260
Maryland	46	48,330	31	12,400	15	35,930	48	37,750	2	475	159	55,860	....	....	13,129,229	121,221,045	134,350,274
District of Columbia	14	15,850	10	4,850	4	11,000	11	9,900	....	....	26	10,825	4	315	75,970,354	8,921,124	84,891,478
Virginia	75	75,984	32	10,084	43	65,900	53	25,125	4	190	99	31,918	....	....	116,299,371	6,810,776	123,110,147
West Virginia	45	19,995	19	7,470	26	12,525	28	6,900	1	75	81	9,732	....	....	59,854,180	7,314,054	67,168,234
North Carolina	49	18,290	22	3,245	27	15,045	28	8,905	1	25	140	44,185	....	....	18,148,568	23,672,933	41,821,501
South Carolina	24	8,578	16	2,263	8	6,315	19	6,775	1	75	23	4,575	1	35	8,804,201	9,071,356	17,875,557
Georgia	67	56,609	19	8,395	48	48,214	45	31,810	2	200	92	49,375	14	1,050	54,510,462	71,309,660	125,820,122
Florida	33	12,710	15	6,250	18	6,460	9	2,195	1	132	4	600	....	....	25,026,663	502,580	25,529,243
EAST SOUTH CENTRAL:																	
Kentucky	17	15,805	13	9,005	4	6,800	26	15,000	2	600	66	14,375	....	....	73,815,374	15,059,597	88,874,971
Tennessee	35	36,050	15	12,100	20	23,950	29	13,860	5	385	205	14,793	....	....	81,760,222	18,312,211	100,072,433
Alabama	38	32,800	21	9,525	17	23,275	12	7,075	2	150	30	11,900	....	....	82,955,108	4,795,740	87,750,848
Mississippi	12	6,650	3	475	9	6,175	10	2,475	1	75	24	2,715	....	....	9,954,975	3,695,094	13,650,069
WEST SOUTH CENTRAL:																	
Arkansas	24	14,107	11	4,557	13	9,550	9	2,875	4	600	11	1,625	....	....	24,838,981	2,524,889	27,363,870
Louisiana	33	32,890	23	15,675	10	17,215	16	5,700	4	656	13	6,450	2	35	86,263,736	23,086,310	109,350,046
Oklahoma	13	7,630	4	765	9	6,865	15	5,335	3	550	24	2,710	....	....	16,393,772	4,082,454	20,476,226
Texas	47	29,621	16	4,410	31	25,211	42	15,450	1	225	52	8,030	4	30	63,858,530	24,030,667	87,889,197
MOUNTAIN:																	
Montana	4	1,070	4	1,070	.....	....	11	1,430	....	....	9	1,275	....	....	1,800,000	8,426,574	10,226,574
Colorado	33	29,692	10	6,850	23	22,842	26	9,750	2	120	67	17,475	....	....	97,915,436	8,458,015	106,373,451
New Mexico	....	....	....	....	.....	....	....	....	....	....	....	....	....	....	....	465,700	465,700
Arizona	2	395	....	....	2	395	1	100	....	....	....	....	....	....	685,400	2,284,107	2,969,507
Idaho	....	....	....	....	.....	....	5	1,950	....	....	....	....	....	....	....	5,108,451	5,108,451
Wyoming	....	....	....	....	.....	....	2	550	....	....	....	....	....	....	....	1,035,845	1,035,845
Nevada	....	....	....	....	.....	....	....	....	....	....	....	....	....	....	....	652,000	652,000
Utah	20	24,900	3	300	17	24,600	23	10,300	1	15	80	34,500	....	....	34,846,894	45,163,875	80,010,769
PACIFIC:																	
Washington	67	152,630	20	9,150	47	143,480	87	55,725	17	1,529	323	307,181	....	....	439,408,062	69,385,927	508,793,989
Oregon	45	38,740	8	4,625	37	34,115	57	34,740	....	....	140	94,631	....	....	169,609,004	12,937,739	182,546,743
California	35	24,467	23	9,567	12	14,900	144	73,959	4	600	339	94,815	1	125	11,274,069	481,625,400	492,899,469

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[1] Includes duplication to the extent to which current generated by railway companies is sold to other railway companies; amount of duplication not ascertainable.

[2] Includes 32,751 kilowatts' capacity of idle equipment, distributed as follows: 64 direct-current dynamos with a total of 15,849 kilowatts' capacity, and 21 alternating-current dynamos with a total of 16,902 kilowatts' capacity.

TABLE 153.—TRACK MILEAGE, BY GEOGRAPHIC

	STATE.	Census.	Total.	MAIN TRACK.			Sidings and turnouts.	Owned by operating company.	LEASED.			OPERATED UNDER TRACKAGE RIGHTS.		
				Total.	Road or first track.	Second (including third, etc.), tracks.			Total.	From electric companies.	From steam companies.	Total.	From electric companies.	From steam companies.
1	UNITED STATES	1912	[1] 41,064.82	38,333.62	30,437.86	7,895.76	2,731.20	[2] 33,467.31	7,511.48	[3] 7,095.71	[4] 415.77	1,284.82	1,051.19	233.63
2		1907	[8] 34,403.56	32,485.87	25,547.19	6,938.68	1,917.69	[9] 27,480.65	7,228.94	[10] 6,946.55	[11] 282.39	692.28	692.28	....
3		1902	[14] 22,589.47	21,681.94	16,651.58	5,030.36	907.53	[15] 19,043.45	3,552.38	[16] 3,498.17	[17] 54.21	559.68	559.68	....
	GEOGRAPHIC DIVISIONS:													
4	New England	1912	5,294.55	4,959.60	4,216.26	743.34	334.95	[21] 3,961.11	1,313.04	[22] 1,270.13	[23] 42.91	93.16	38.44	54.72
5		1907	4,883.39	4,612.10	3,955.69	656.41	271.29	3,845.66	1,063.99	1,062.75	1.24	54.73	54.73	....
6		1902	4,012.79	3,795.93	3,304.78	491.15	216.86	3,432.43	581.60	580.36	1.24	98.34	98.34	....
7	Middle Atlantic	1912	10,043.03	9,402.14	6,980.09	2,422.05	640.89	[24] 6,716.02	3,277.02	[25] 3,069.40	[26] 207.62	501.50	425.91	75.59
8		1907	8,829.98	8,307.18	6,198.72	2,108.46	522.80	5,616.11	3,238.32	3,067.46	170.86	199.91	199.91	....
9		1902	6,162.16	5,881.43	4,397.44	1,483.99	280.73	4,175.35	1,986.81	1,950.39	36.42	134.99	134.99	....
10	East North Central	1912	11,809.69	11,096.19	9,170.53	1,925.66	713.50	9,826.45	1,972.65	1,941.94	[27] 30.71	349.13	338.54	10.59
11		1907	10,342.17	9,809.15	8,128.24	1,680.91	533.02	8,046.39	2,296.58	2,267.29	29.29	341.50	341.50	....
12		1902	6,077.02	5,852.37	4,484.65	1,367.72	224.65	5,470.29	611.85	599.06	12.79	228.06	228.06	....
13	West North Central	1912	3,098.62	2,864.96	2,129.73	735.23	233.66	[28] 3,038.81	52.00	[29] 39.37	[30] 12.63	74.50	60.18	14.32
14		1907	2,508.36	2,365.95	1,704.47	661.48	142.41	2,409.16	99.20	35.51	63.69	40.87	40.87	....
15		1902	1,740.72	1,683.51	1,146.94	536.57	57.21	1,379.83	360.89	360.89	....	15.75	15.75	....
16	South Atlantic	1912	2,962.28	2,782.65	2,199.21	583.44	179.63	[32] 2,445.35	517.83	[33] 449.30	[34] 68.53	68.83	53.44	15.39
17		1907	2,300.73	2,204.60	1,717.22	487.38	96.13	2,186.31	114.42	107.57	6.85	19.32	19.32	....
18		1902	1,670.15	1,631.85	1,195.29	436.56	38.30	1,660.47	9.68	5.92	3.76	49.07	49.07	....
19	East South Central	1912	1,287.26	1,225.11	948.45	276.66	62.15	[36] 1,280.41	7.93	3.30	[37] 4.63	39.32	38.40	0.92
20		1907	1,064.69	998.92	761.73	237.19	65.77	1,060.42	4.27	....	4.27	4.88	4.88	....
21		1902	768.17	740.71	579.87	160.84	27.46	768.17	....	....	....	12.41	12.41	....
22	West South Central	1912	1,376.23	1,296.23	1,105.62	190.61	80.00	[38] 1,242.82	143.30	[39] 142.25	[40] 1.05	22.51	22.25	0.26
23		1907	841.22	799.61	649.44	150.17	41.61	721.94	119.28	119.28	....	13.54	13.54	....
24		1902	554.28	537.94	427.23	110.71	16.34	554.28	....	....	....	6.40	6.40	....
25	Mountain	1912	1,007.32	937.75	793.96	143.79	69.57	897.49	88.22	[41] 80.04	8.18	54.57	31.14	23.43
26		1907	601.39	567.76	434.82	132.94	33.63	593.64	9.93	9.93	....	....	....	....
27		1902	409.48	395.42	287.69	107.73	14.06	407.93	1.55	1.55	....	....	....	....
28	Pacific	1912	4,185.84	3,768.99	2,894.01	874.98	416.85	[42] 4,058.85	139.49	[43] 99.98	39.51	81.30	42.89	38.41
29		1907	3,031.63	2,820.60	1,996.86	823.74	211.03	3,001.02	282.95	276.76	6.19	17.53	17.53	....
30		1902	1,194.70	1,162.78	827.69	335.09	31.92	1,194.70	....	....	....	14.66	14.66	....
	NEW ENGLAND:													
31	Maine	1912	536.38	506.68	486.16	20.52	29.70	430.01	106.37	106.37	....	....	....	....
32		1907	424.06	404.05	387.26	16.79	20.01	424.06	....	....	....	3.50	3.50	....
33		1902	331.55	318.60	304.71	13.89	12.95	328.08	3.47	3.47	....	1.90	1.90	....
34	New Hampshire	1912	246.26	232.02	217.42	14.60	14.24	215.54	30.72	....	30.72	2.62	2.62	....
35		1907	247.10	235.10	225.12	9.98	12.00	247.10	....	....	....	1.79	1.79	....
36		1902	167.65	160.32	155.03	5.29	7.33	111.43	56.22	56.22	....	....	....	....
37	Vermont	1912	102.85	97.32	96.65	0.67	5.53	102.85	....	....	....	....	....	....
38		1907	124.31	117.48	116.81	0.67	6.83	124.31	....	....	....	....	....	....
39		1902	80.55	76.70	76.20	0.50	3.85	80.55	....	....	....	....	....	....
40	Massachusetts	1912	3,010.48	2,802.39	2,328.30	474.09	208.09	[21] 2,467.17	577.63	[22] 576.14	[44] 1.49	32.78	32.78	....
41		1907	2,886.85	2,721.85	2,278.12	443.73	165.00	2,339.88	573.23	571.99	1.24	45.14	45.14	....
42		1902	2,525.65	2,377.58	2,037.79	339.79	148.07	2,040.41	486.48	485.24	1.24	74.07	74.07	....
43	Rhode Island	1912	395.71	358.48	309.14	49.34	37.23	54.77	340.94	330.70	10.24	....	....	....
44		1907	419.92	385.23	329.18	56.05	34.69	146.97	272.95	272.95	....	....	....	....
45		1902	328.90	312.18	270.00	42.18	16.72	328.90	....	....	....	7.43	7.43	....
46	Connecticut	1912	1,002.87	962.71	778.59	184.12	40.16	690.77	257.38	256.92	0.46	57.76	3.04	54.72
47		1907	781.15	748.39	619.20	129.19	32.76	563.34	217.81	217.81	....	4.30	4.30	....
48		1902	578.49	550.55	461.05	89.50	27.94	543.06	35.43	35.43	....	14.94	14.94	....

[1] Excludes 23.49 miles not operated, 31.22 miles leased to steam roads, and a duplication of 92.89 miles leased from operating companies.
[2] Includes 19.23 miles not operated and 31.22 miles leased to steam roads.
[3] Includes 4.26 miles not operated and 92.89 miles leased from operating companies.
[4] Includes 5.67 miles leased from manufacturing companies, 7.91 miles leased from bridge companies, 7.21 miles on bridges owned by city of New York, and 5.79 miles leased from city of Cleveland.
[5] Includes 1.25 miles monorail.
[6] Includes 38.81 miles gas-electric, 62.23 miles storage battery, and 2.44 miles storage battery and gasoline motor.
[7] Gasoline motor.
[8] Includes 17.05 miles not operated and 5 miles leased to steam road.
[9] Includes 16.68 miles not operated and 5 miles leased to steam road.
[10] Includes 0.37 mile not operated and 306.03 miles leased from operating companies.
[11] Includes 1.24 miles leased from manufacturing company, 8.89 miles leased from bridge companies, 9.60 miles on bridges owned by city of New York, and 4.64 miles leased from city of Cleveland.
[12] Includes 22.50 miles gas-electric and 3 miles storage battery.
[13] Figures not available.
[14] Includes 12.48 miles of duplicated track and 4.47 miles not operated, and excludes 5.12 miles of duplicated track and 1.24 miles trackage right from steam road.
[15] Includes 4.47 miles not operated.
[16] Includes 17.60 miles leased from operating companies.
[17] Includes track leased from bridge companies, 1.24 miles given in prior censuses as trackage rights not carried into total, and 0.25 mile leased from a city.
[18] Storage battery.
[19] Compressed air.
[20] Trackage not reported.
[21] Includes 4.07 miles not operated.

DIVISIONS AND STATES: 1912, 1907, AND 1902.

CLASSIFIED ACCORDING TO MOTIVE POWER.																
Electric.																
Total.	Line transmission.			Other.	Cable.	Animal.	Steam.	Other.	Surface.	Elevated.	Subway and tunnels.	City and suburban lines.	Interurban lines.	On public thoroughfares.	On private right of way.	
	Overhead trolley.	Third rail.	Conduit trolley.													
40,808.39	[5] 38,958.06	1,395.13	351.72	[6] 103.48	56.41	57.52	76.34	[7] 66.16	40,532.02	420.10	112.70	24,699.02	16,365.80	26,271.10	14,793.72	1
34,059.69	32,501.71	1,209.78	322.70	[12] 25.50	61.71	136.11	105.06	[7] 40.99	33,966.40	366.59	70.57	(13)	(13)	23,431.72	10,971.84	2
21,901.53	21,290.09	342.91	266.06	[18] 2.47	240.69	259.10	169.61	[19] 6.06	22,268.05	308.94	(20)	(13)	(13)	18,774.92	3,802.07	3
5,280.01	5,246.05	33.96	...	...	...	3.10	10.24	1.20	5,249.52	26.58	18.45	3,906.14	1,388.41	4,414.70	879.85	4
4,879.96	4,860.77	19.19	...	...	...	3.00	0.43	...	4,858.94	16.70	7.75	...	...	4,312.06	571.33	5
4,009.79	3,942.45	67.34	...	...	...	3.00	...	...	3,996.77	16.02	...	...	...	3,646.97	365.82	6
9,990.71	[5] 9,068.62	640.28	236.54	[18] 45.27	4.92	41.99	5.41	...	9,707.35	245.04	90.64	6,583.83	3,459.20	6,655.58	3,387.45	7
8,714.80	7,828.43	659.81	226.56	...	5.94	93.30	15.94	...	8,548.64	219.54	61.80	...	...	6,084.17	2,745.81	8
5,917.52	5,607.48	130.18	178.89	0.97	11.26	117.20	100.06	6.06	5,967.14	184.96	...	...	...	5,208.08	944.02	9
11,764.76	11,301.67	463.09	...	...	0.61	2.45	15.87	26.00	11,663.62	144.20	1.87	4,616.92	7,192.77	6,188.72	5,620.97	10
10,257.22	9,888.55	365.67	...	3.00	1.21	4.00	45.25	34.49	10,215.80	125.77	0.60	...	...	5,721.84	4,620.33	11
5,962.57	5,815.39	145.39	0.29	1.50	92.31	19.72	...	...	5,966.64	107.96	...	...	...	4,655.41	1,419.19	12
3,089.71	3,050.90	...	...	[31] 38.81	5.10	3.81	...	...	3,095.39	2.88	0.35	2,277.67	820.95	2,170.06	928.56	13
2,459.85	2,437.35	...	...	22.50	3.60	17.02	24.89	3.00	2,504.76	3.18	0.42	...	...	1,846.12	662.24	14
1,671.26	1,671.26	...	...	...	33.00	36.46	...	...	1,740.72	...	...	...	...	1,503.31	237.41	15
2,922.09	2,787.51	...	115.18	[35] 19.40	0.76	...	15.08	24.35	2,960.88	1.40	...	2,106.07	856.21	1,942.71	1,019.57	16
2,292.45	2,196.31	...	96.14	...	...	5.53	1.50	1.25	2,299.33	1.40	...	...	...	1,544.38	756.35	17
1,656.47	1,569.59	...	86.88	...	...	13.68	...	...	1,670.15	...	...	...	...	1,221.12	449.03	18
1,285.41	1,285.41	...	...	...	1.36	0.49	...	...	1,286.96	...	0.30	1,123.40	163.86	941.20	346.06	19
1,052.81	1,052.81	...	...	...	0.88	...	11.00	...	1,064.69	...	...	...	...	817.96	246.73	20
731.34	731.34	...	...	...	1.80	3.03	32.00	...	768.17	...	...	...	...	647.52	120.65	21
1,363.05	1,363.05	...	...	...	...	5.68	...	7.50	1,376.23	...	...	1,054.50	321.73	1,016.48	359.75	22
831.19	831.19	...	...	...	...	7.78	...	2.25	841.22	...	...	...	...	742.94	98.28	23
539.09	539.09	...	...	...	...	15.19	...	...	554.28	...	...	...	...	495.22	59.06	24
1,001.19	1,001.19	...	...	...	...	...	6.13	...	1,007.32	...	...	669.37	337.95	682.66	324.66	25
601.39	601.39	...	...	...	...	...	...	...	601.39	...	...	...	...	488.31	113.08	26
401.03	401.03	...	...	...	...	8.45	...	...	409.48	...	...	...	...	386.81	22.67	27
4,111.46	3,853.66	257.80	...	...	43.66	...	23.61	7.11	4,184.75	...	1.09	2,361.12	1,824.72	2,258.99	1,926.85	28
2,970.02	2,804.91	165.11	...	...	50.08	5.48	6.05	...	3,031.63	...	...	...	...	1,873.94	1,157.69	29
1,012.46	1,012.46	...	...	...	102.32	42.37	37.55	...	1,194.70	...	...	...	...	1,010.48	184.22	30
533.28	533.28	...	...	...	...	3.10	...	...	536.38	...	...	263.60	272.78	441.08	95.30	31
421.06	421.06	...	...	...	...	3.00	...	...	424.06	...	...	...	...	356.27	67.79	32
328.55	328.55	...	...	...	...	3.00	...	...	331.55	...	...	...	...	301.27	30.28	33
246.26	246.26	...	...	...	...	...	...	...	246.26	...	...	139.56	106.70	199.20	47.06	34
247.10	247.10	...	...	...	...	...	...	...	247.10	...	...	...	...	196.34	50.76	35
167.65	167.65	...	...	...	...	...	...	...	167.65	...	...	...	...	163.10	4.55	36
102.85	102.85	...	...	...	...	...	...	...	102.85	...	...	74.61	28.24	70.32	32.53	37
124.31	124.31	...	...	...	...	...	...	...	124.31	...	...	...	...	86.67	37.64	38
80.55	80.55	...	...	...	...	...	...	...	80.55	...	...	...	...	72.76	7.79	39
3,009.28	2,975.32	33.96	...	...	...	...	...	1.20	2,965.45	26.58	18.45	2,214.69	795.79	2,717.08	293.40	40
2,886.42	2,867.23	19.19	...	...	...	...	0.43	...	2,862.40	16.70	7.75	...	...	2,622.61	264.24	41
2,525.65	2,484.20	41.45	...	...	...	...	...	...	2,509.63	16.02	...	...	...	2,347.90	177.75	42
385.47	385.47	...	...	...	...	...	10.24	...	395.71	...	...	384.83	10.88	310.06	85.65	43
419.92	419.92	...	...	...	...	...	...	...	419.92	...	...	...	...	312.67	107.25	44
328.90	328.90	...	...	...	...	...	...	...	328.90	...	...	...	...	256.01	72.89	45
1,002.87	1,002.87	...	...	...	...	...	...	...	1,002.87	...	...	828.85	174.02	676.96	325.91	46
781.15	781.15	...	...	...	...	...	...	...	781.15	...	...	...	...	737.50	43.65	47
578.49	552.60	25.89	...	...	...	...	...	...	578.49	...	...	...	...	505.93	72.56	48

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[22] Includes 3.75 miles not operated and 26.50 miles leased from operating companies.
[23] Includes 1.49 miles leased from a manufacturing company.
[24] Includes 6.06 miles not operated.
[25] Includes 0.33 mile not operated and 19.21 miles leased from operating companies.
[26] Includes 7.21 miles on bridges owned by city of New York.
[27] Includes 5.79 miles leased from city of Cleveland and 1.52 miles leased from a bridge company.
[28] Includes 4 miles not operated.
[29] Includes 2.51 miles leased from operating company.
[30] Includes 0.63 mile leased from bridge company.
[31] Gas-electric.
[32] Includes 5 miles leased to a steam road.
[33] Includes 11.29 miles leased from operating company.
[34] Includes 4.18 miles leased from a manufacturing company and 0.58 mile leased from a bridge company.
[35] Includes 16.96 miles storage battery and 2.44 miles storage battery and gasoline motor.
[36] Includes 2 miles not operated.
[37] Includes 4.13 miles leased from bridge companies.
[38] Includes 1.64 miles not operated.
[39] Includes 8.51 miles leased from operating companies.
[40] Leased from a bridge company.
[41] Includes 1.82 miles leased from operating companies.
[42] Includes 1.46 miles not operated and 26.22 miles leased to steam road.
[43] Includes 0.18 mile not operated and 23.05 miles leased from operating companies.
[44] Leased from a manufacturing company.

Table 153.—TRACK MILEAGE, BY GEOGRAPHIC

	STATE.	Census.	Total.	MAIN TRACK.			Sidings and turnouts.	Owned by operating company.	LEASED.			OPERATED UNDER TRACKAGE RIGHTS.		
				Total.	Road or first track.	Second (including third, etc.), tracks.			Total.	From electric companies.	From steam companies.	Total.	From electric companies.	From steam companies.
	MIDDLE ATLANTIC:													
49	New York	1912	4,605.44	4,274.28	2,813.57	1,460.71	331.16	[1] 3,817.40	757.61	[2] 594.39	[3] 163.22	395.07	340.92	54.15
50		1907	3,884.74	3,595.54	2,409.66	1,185.88	289.20	2,877.14	1,032.05	866.87	165.18	135.98	135.98	...
51		1902	2,818.97	2,669.72	1,822.31	847.41	149.25	2,296.31	522.66	486.24	36.42	91.20	91.20	...
52	New Jersey	1912	1,319.85	1,230.31	897.33	332.98	89.54	738.75	579.37	537.59	41.78	11.33	9.60	1.73
53		1907	1,324.12	1,262.09	884.85	377.24	62.03	926.99	397.13	397.13	...	35.32	35.32	...
54		1902	861.28	833.19	573.57	259.62	28.09	623.37	237.91	237.91	...	7.30	7.30	...
55	Pennsylvania	1912	4,117.74	3,897.55	3,269.19	628.36	220.19	2,159.87	1,940.04	[6] 1,937.42	2.62	95.10	75.39	19.71
56		1907	3,621.12	3,449.55	2,904.21	545.34	171.57	1,811,98	1,809.14	1,803.46	5.68	28.61	28.61	...
57		1902	2,481.91	2,378.52	2,001.56	376.96	103.39	1,255.67	1.226.24	1,226.24	...	36.49	36.49	...
	EAST NORTH CENTRAL:													
58	Ohio	1912	4,069.12	3,851.95	3,227.84	624.11	217.17	2,946.71	1,119.11	1,106.82	[7] 12.29	152.41	149.11	3.30
59		1907	3,767.10	3,595.97	3,070.38	525.59	171.13	2,718.08	1,049.02	1,042.38	6.64	138.65	138.65	...
60		1902	2,353.43	2,282.51	1,858.85	423.66	70.92	2,106.33	252.22	252.22	...	116.33	116.33	...
61	Indiana	1912	2,301.34	2,182.15	2,038.97	143.18	119.19	1,788.82	512.52	507.46	5.06	89.50	89.50	...
62		1907	1,932.93	1,840.74	1,714.61	126.13	92.19	1,159.68	773.25	767.75	5.50	94.54	94.54	...
63		1902	646.66	623.17	523.60	99.57	23.49	646.66	...	...	...	22.84	22.84	...
64	Illinois	1912	3,125.84	2,897.60	2,182.04	715.56	228.24	3,044.12	76.56	65.88	[8] 10.68	81.05	75.89	5.16
65		1907	2,776.46	2,617.84	1,944.69	673.15	158.62	2,302.95	474.31	457.16	17.15	95.86	95.86	...
66		1902	1,637.62	1,576.22	992.85	583.37	61.40	1,277.99	359.63	346.84	12.79	54.04	54.04	...
67	Michigan	1912	1,507.26	1,396.29	1,139.65	256.64	110.97	1,248.67	256.46	253.78	2.68	15.79	13.66	2.13
68		1907	1,275.03	1,183.92	982.34	201.58	91.11	1,275.03	...	...	...	10.98	10.98	...
69		1902	1,022.81	967.63	810.22	157.41	55.18	1,022.81	...	...	...	34.85	34.85	...
70	Wisconsin	1912	806.13	768.20	582.03	186.17	37.93	798.13	8.00	8.00	...	10.38	10.38	...
71		1907	590.65	570.68	416.22	154.46	19.97	590.65	...	...	...	1.47	1.47	...
72		1902	416.50	402.84	299.13	103.71	13.66	416.50	...	...	...	...	...	...
	WEST NORTH CENTRAL:													
73	Minnesota	1912	555.18	522.20	328.89	193.31	32.98	544.35	10.83	...	10.83	...	...	...
74		1907	457.15	431.65	260.32	171.33	25.50	457.15	...	...	...	...	...	...
75		1902	338.17	318.41	189.64	128.77	19.76	338.17	...	...	...	...	...	...
76	Iowa	1912	803.87	720.17	638.92	81.25	83.70	788.25	3.16	3.16	...	51.26	38.80	12.46
77		1907	639.84	594.63	528.93	65.70	45.21	578.62	61.22	3.13	58.09	35.94	35.94	...
78		1902	378.25	360.53	315.73	44.80	17.72	378.25	...	...	...	8.65	8.65	...
79	Missouri	1912	996.00	920.68	579.25	341.43	75.32	[10] 997.51	3.14	[11] 2.51	[12] 0.63	14.68	12.82	1.86
80		1907	921.67	878.84	538.84	340.00	42.83	917.07	4.60	...	4.60	...	...	...
81		1902	758.38	750.00	453.61	296.39	8.38	397.49	360.89	360.89	...	7.10	7.10	...
82	North Dakota	1912	26.02	24.28	24.23	...	1.74	26.02	...	...	...	...	...	...
83		1907	16.09	15.50	15.50	...	0.59	16.09	...	...	...	...	...	...
84	South Dakota	1912	21.59	20.71	13.20	7.51	0.88	21.59	...	...	...	...	...	...
85		1907	5.00	4.50	4.50	...	0.50	5.00	...	...	...	...	...	...
86		1902	2.00	2.00	2.00	...	...	2.00	...	...	...	...	...	...
87	Nebraska	1912	243.80	226.78	149.89	76.89	17.02	210.10	33.70	33.70	...	5.89	5.89	...
88		1907	218.73	206.77	137.71	69.06	11.96	186.35	32.38	32.38	...	4.93	4.93	...
89		1902	113.66	108.21	66.08	42.13	5.45	113.66	...	...	...	...	...	...
90	Kansas	1912	452.16	430.14	395.30	34.84	22.02	450.99	1.17	...	1.17	2.67	2.67	...
91		1907	249.88	234.06	218.67	15.39	15.82	248.88	1.00	...	1.00	...	...	...
92		1902	150.26	144.36	119.88	24.48	5.90	150.26	...	...	...	...	...	...
	SOUTH ATLANTIC:													
93	Delaware	1912	90.37	85.61	74.37	11.24	4.76	46.30	44.07	44.07	...	...	...	...
94		1907	95.93	93.69	82.45	11.24	2.24	84.32	11.61	11.61	...	...	...	...
95		1902	85.61	83.00	71.55	11.45	2.61	85.61	...	...	...	4.05	4.05	...
96	Maryland	1912	692.51	645.43	419.92	225.51	47.08	643.13	47.68	43.50	[14] 4.18	22.69	20.99	1.70
97		1907	536.18	515.67	330.12	185.55	20.51	525.76	10.42	10.42	...	2.50	2.50	...
98		1902	437.84	435.21	258.78	176.43	2.63	431.92	5.92	5.92	...	1.19	1.19	...
99	District of Columbia	1912	214.23	199.45	112.27	87.18	14.78	214.23	...	...	...	6.09	6.09	...
100		1907	176.03	168.96	90.11	78.85	7.07	176.03	...	...	...	6.70	6.70	...
101		1902	161.97	161.97	82.68	79.29	...	161.97	...	...	...	6.70	6.70	...
102	Virginia	1912	561.86	527.83	418.57	109.26	34.03	429.29	132.25	69.36	62.89	6.25	5.93	0.32
103		1907	515.54	485.64	385.17	100.47	29.90	456.30	59.24	55.80	3.44	6.04	6.04	...
104		1902	359.30	345.08	266.84	78.24	14.22	355.79	3.51	...	3.51	20.13	20.13	...
105	West Virginia	1912	404.98	388.23	369.53	18.70	16.75	392.48	22.79	[15] 21.33	[16] 1.46	3.01	2.01	1.00
106		1907	266.41	256.98	247.73	9.25	9.43	255.22	11.19	11.19	...	1.07	1.07	...
107		1902	140.00	136.49	133.06	3.43	3.51	140.00	...	...	...	0.56	0.56	...
108	North Carolina	1912	190.26	171.29	154.48	16.81	18.97	161.83	28.43	28.43	...	10.42	10.42	...
109		1907	106.94	100.79	93.66	7.13	6.15	85.98	20.96	18.55	2.41	...	...	...
110		1902	46.32	42.65	39.44	3.21	3.67	46.07	0.25	...	0.25	12.44	12.44	...
111	South Carolina	1912	202.60	183.96	168.95	15.01	18.64	158.77	43.83	43.83	...	2.00	2.00	...
112		1907	131.26	126.48	116.87	9.61	4.78	131.26	...	...	...	...	...	...
113		1902	76.98	73.98	63.33	10.65	3.00	76.98	...	...	...	1.00	1.00	...

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[1] Includes 6.06 miles not operated.
[2] Includes 0.33 mile not operated and 17.33 miles leased from operating companies.
[3] Includes 7.21 miles on bridges owned by city of New York.
[4] Inclndes 1.25 miles monorail.
[5] Storage battery.
[6] Includes 1.88 miles leased from operating companies.
[7] Includes 5.79 miles leased from city of Cleveland.
[8] Includes 1.52 miles leased from a bridge company.

DIVISIONS AND STATES: 1912, 1907, AND 1902—Continued.

CLASSIFIED ACCORDING TO MOTIVE POWER.									Surface.	Elevated.	Subway and tunnels.	City and suburban lines.	Interurban lines.	On public thoroughfares.	On private right of way.	
Electric.					Cable.	Animal.	Steam.	Other.								
Total.	Line transmission.			Other.												
	Overhead trolley.	Third rail.	Conduit trolley.													
4,563.45	[4]3,802.08	496.66	236.54	[5]28.17	....	41.99	....	....	4,292.42	230.80	82.22	2,988.92	1,616.52	3,027.31	1,578.13	49
3,788.24	3,145.82	415.86	226.56	....	1.15	93.30	2.05	....	3,623.95	204.61	56.18	....	....	2,683.46	1,201.28	50
2,590.16	2,280.12	130.18	178.89	0.97	3.96	115.17	94.56	6.06	2,624.95	184.96	....	....	....	2,402.65	407.26	51
1,319.85	1,310.29	9.56	....	....	....	....	....	....	1,315.48	4.37	....	1,052.15	267.70	936.93	382.92	52
1,324.12	1,191.67	132.45	....	....	....	....	....	....	1,316.86	7.26	....	....	....	921.35	402.77	53
858.66	858.66	....	....	....	1.40	1.22	....	....	861.28	....	....	....	....	763.15	98.13	54
4,107.41	3,956.25	134.06	....	[5]17.10	4.92	....	5.41	....	4,099.45	9.87	8.42	2,542.76	1,574.98	2,691.34	1,426.40	55
3,602.44	3,490.94	111.50	....		4.79	....	13.89	....	3,607.83	7.67	5.62	....	....	2,479.36	1,141.76	56
2,468.70	2,468.70	....	....	....	5.90	0.81	5.50	....	2,480.91	....	....	....	....	2,042.28	438.63	57
4,067.06	3,995.88	71.18	....	....	0.61	1.45	....	....	4,069.12	....	....	1,321.70	2,747.42	2,179.61	1,889.51	58
3,723.04	3,651.94	71.10	....	....	0.61	1.45	42.00	....	3,767.10	....	....	....	....	2,109.88	1,657.22	59
2,351.32	2,351.32	....	....	....	0.61	1.50	....	....	2,353.43	....	....	....	....	1,716.96	636.47	60
2,298.27	2,298.27	....	....	....	....	1.00	2.07	....	2,301.34	....	....	524.40	1,776.94	705.47	1,595.87	61
1,928.68	1,928.68	....	....	....	....	1.00	3.25	....	1,932.93	....	....	....	....	636.99	1,295.94	62
643.87	643.87	....	....	....	....	2.79	....	....	646.66	....	....	....	....	468.74	177.92	63
3,086.04	2,832.71	253.33	....	....	....	....	13.80	26.00	2,979.77	144.20	1.87	1,783.15	1,342.69	1,864.58	1,261.26	64
2,739.82	2,523.38	213.44	....	3.00	0.60	1.55	....	34.49	2,650.09	125.77	0.60	....	....	1,727.16	1,049.30	65
1,528.07	1,417.81	108.76	....	1.50	91.70	15.43	....	....	1,527.24	107.96	....	....	....	1,420.83	214.37	66
1,507.26	1,368.68	138.58	....	....	....	....	....	....	1,507.26	....	....	595.83	911.43	970.38	536.88	67
1,275.03	1,193.90	81.13	....	....	....	....	....	....	1,275.03	....	....	....	....	831.86	443.17	68
1,022.81	985.89	36.63	0.29	....	....	....	....	....	1,022.81	....	....	....	....	700.93	321.88	69
806.13	806.13	....	....	....	....	....	....	....	806.13	....	....	391.84	414.29	468.68	337.45	70
590.65	590.65	....	....	....	....	....	....	....	590.65	....	....	....	....	415.95	174.70	71
416.50	416.50	....	....	....	....	....	....	....	416.50	....	....	....	....	347.95	68.55	72
552.55	513.74	....	....	[9]38.81	2.63	....	....	....	555.18	....	....	516.37	38.81	453.51	101.67	73
456.02	456.02	....	....	....	1.13	....	....	....	457.15	....	....	....	....	401.21	55.94	74
338.17	338.17	....	....	....	....	....	....	....	338.17	....	....	....	....	324.59	13.58	75
803.87	803.87	....	....	....	....	....	....	....	803.87	....	....	376.88	426.99	454.96	348.91	76
619.45	619.45	....	....	....	....	....	20.39	....	639.84	....	....	....	....	331.32	308.52	77
374.43	374.43	....	....	....	....	3.82	....	....	378.25	....	....	....	....	298.78	79.47	78
993.53	993.53	....	....	....	2.47	....	....	....	992.87	2.88	0.25	913.43	82.57	774.31	221.69	79
919.20	919.20	....	....	....	2.47	....	....	....	918.07	3.18	0.42	....	....	744.63	177.04	80
719.48	719.48	....	....	....	33.00	5.90	....	....	758.38	....	....	....	....	629.51	128.87	81
26.02	26.02	....	....	....	....	....	....	....	26.02	....	....	22.43	3.59	24.08	1.94	82
16.09	16.09	....	....	....	....	....	....	....	16.09	....	....	....	....	16.09	....	83
21.59	21.59	....	....	....	....	....	....	....	21.59	....	....	21.59	....	19.94	1.65	84
5.00	5.00	....	....	....	....	....	....	....	5.00	....	....	....	....	5.00	....	85
....	....	....	....	....	....	2.00	....	....	2.00	....	....	....	....	2.00	....	86
242.00	242.00	....	....	....	....	1.80	....	....	243.80	....	....	218.16	25.64	227.02	16.78	87
211.01	211.01	....	....	....	....	3.22	4.50	....	218.73	....	....	....	....	195.66	23.07	88
110.55	110.55	....	....	....	....	3.11	....	....	113.66	....	....	....	....	111.33	2.33	89
450.15	450.15	....	....	....	....	2.01	....	....	452.06	....	0.10	208.81	243.35	216.24	235.92	90
233.08	210.58	....	....	22.50	....	13.80	....	3.00	249.88	....	....	....	....	152.21	97.67	91
128.63	128.63	....	....	....	....	21.63	....	....	150.26	....	....	....	....	137.10	13.16	92
90.37	79.57	....	....	[5]10.80	....	....	....	....	90.37	....	....	79.57	10.80	67.17	23.20	93
95.93	95.93	....	....	....	....	....	....	....	95.93	....	....	....	....	71.19	24.74	94
85.61	85.61	....	....	....	....	....	....	....	85.61	....	....	....	....	58.31	27.30	95
685.68	682.52	....	....	[5]3.16	....	....	6.83	....	691.11	1.40	....	458.88	233.63	459.61	232.90	96
536.18	536.18	....	....	....	....	....	....	....	534.78	1.40	....	....	....	306.25	229.93	97
437.84	437.84	....	....	....	....	....	....	....	437.84	....	....	....	....	223.02	214.82	98
214.23	99.94	....	111.85	[13]2.44	....	....	....	....	214.23	....	....	214.23	....	163.84	50.39	99
176.03	83.17	....	92.86	....	....	....	....	....	176.03	....	....	....	....	138.34	37.69	100
161.97	76.89	....	85.08	....	....	....	....	....	161.97	....	....	....	....	125.16	36.81	101
554.88	551.55	....	3.33	....	0.76	....	6.22	....	561.86	....	....	429.70	132.16	301.87	259.99	102
515.54	512.26	....	3.28	....	....	....	....	....	515.54	....	....	....	....	286.85	228.69	103
357.30	355.50	....	1.80	....	....	2.00	....	....	359.30	....	....	....	....	275.72	83.58	104
404.98	404.98	....	....	....	....	....	....	....	404.98	....	....	147.76	257.22	245.77	159.21	105
266.41	266.41	....	....	....	....	....	....	....	266.41	....	....	....	....	223.26	43.15	106
140.00	140.00	....	....	....	....	....	....	....	140.00	....	....	....	....	116.70	23.30	107
188.23	188.23	....	....	....	....	....	2.03	....	190.26	....	....	138.13	52.13	137.60	52.66	108
104.19	104.19	....	....	....	....	....	1.50	1.25	106.94	....	....	....	....	79.93	27.01	109
46.32	46.32	....	....	....	....	....	....	....	46.32	....	....	....	....	35.59	10.73	110
202.60	199.60	....	....	[5]3.00	....	....	....	....	202.60	....	....	112.65	89.95	105.23	97.37	111
129.76	129.76	....	....	....	....	1.50	....	....	131.26	....	....	....	....	73.06	58.20	112
73.80	73.80	....	....	....	....	3.18	....	....	76.98	....	....	....	....	58.85	18.13	113

[9] Gas-electric.
[10] Includes 4 miles not operated.
[11] Includes 2.51 miles leased from operating company.
[12] Includes 0.63 mile leased from bridge company.
[13] Storage battery and gasoline motor.
[14] Leased from a manufacturing company.
[15] Includes 11.29 miles leased from operating company.
[16] Includes 0.58 mile leased from a bridge company.

Table 153.—TRACK MILEAGE, BY GEOGRAPHIC

	STATE.	Census.	Total.	MAIN TRACK.			Sidings and turnouts.	Owned by operating company.	LEASED.			OPERATED UNDER TRACKAGE RIGHTS.		
				Total.	Road or first track.	Second (including third, etc.), tracks.			Total.	From electric companies.	From steam companies.	Total.	From electric companies.	From steam companies.
	SOUTH ATLANTIC—Contd.													
114	Georgia	1912	440.63	428.63	340.51	88.12	12.00	[1] 246.85	198.78	198.78	....	6.00	6.00	....
115		1907	354.18	342.85	264.29	78.56	11.33	354.18	....	....	....	3.01	3.01	....
116		1902	300.38	294.40	222.18	72.22	5.98	300.38	....	....	....	3.00	3.00	....
117	Florida	1912	164.84	152.22	140.61	11.61	12.62	152.47	....	....	....	12.37	....	12.37
118		1907	118.26	113.54	106.82	6.72	4.72	117.26	1.00	....	1.00	....	....	....
119		1902	61.75	59.07	57.43	1.64	2.68	61.75	....	....	....	....	....	....
	EAST SOUTH CENTRAL:													
120	Kentucky	1912	493.21	475.37	356.74	118.63	17.84	490.02	3.19	....	[2] 3.19	32.80	32.80	....
121		1907	389.13	375.35	268.28	107.07	13.78	385.36	3.77	....	3.77	4.88	4.88	....
122		1902	283.95	280.45	188.56	91.89	3.50	283.95	....	....	....	12.41	12.41	....
123	Tennessee	1912	370.28	350.16	259.05	91.11	20.12	369.34	0.94	....	[2] 0.94	5.60	5.60	....
124		1907	297.50	276.38	198.90	77.48	21.12	297.50	....	....	....	....	....	....
125		1902	254.20	246.50	199.87	46.63	7.70	254.20	....	....	....	....	....	....
126	Alabama	1912	306.63	290.44	225.62	64.82	16.19	[3] 303.91	3.80	3.30	0.50	0.92	....	0.92
127		1907	291.66	265.87	214.73	51.14	25.79	291.16	0.50	....	0.50	....	....	....
128		1902	204.72	189.45	167.70	21.75	15.27	204.72	....	....	....	....	....	....
129	Mississippi	1912	117.14	109.14	107.04	2.10	8.00	117.14	....	....	....	....	....	....
130		1907	86.40	81.32	79.82	1.50	5.08	86.40	....	....	....	....	....	....
131		1902	25.30	24.31	23.74	0 57	0.99	25.30	....	....	....	....	....	....
	WEST SOUTH CENTRAL:													
132	Arkansas	1912	122.92	116.14	95.15	20.99	6.78	122.25	0.67	....	[2] 0.67	....	....	....
133		1907	87.39	83.03	63.45	19.58	4.36	87.39	....	....	....	....	....	....
134		1902	52.49	50.00	38.01	11.99	2.49	52.49	....	....	....	....	....	....
135	Louisiana	1912	285.10	268.40	198.67	69.73	16.70	155.55	129.55	129.55	....	....	....	....
136		1907	238.52	226.54	161.76	64.78	11.98	119.24	119.28	119.28	....	4.61	4.61	....
137		1902	198.52	193.58	134.67	58.91	4.94	198.52	....	....	....	0.32	0.32	....
138	Oklahoma	1912	251.56	232.17	214.48	17.69	19.39	[4] 251.61	0.27	0.27	....	0.26	....	0.26
139		1907	100.44	96.47	89.00	7.47	3.97	100.44	....	....	....	....	....	....
140	Texas	1912	716.65	679.52	597.32	82.20	37.13	[5] 713.41	12.81	[6] 12.43	[2] 0.38	22.25	22.25	....
141		1907	414.87	393.57	335.23	58.34	21.30	414.87	....	....	....	8.93	8.93	....
142		1902	303.27	294.36	254.55	39.81	8.91	303.27	....	....	....	6.08	6.08	....
	MOUNTAIN:													
143	Montana	1912	99.22	94.05	82.37	11.68	5.17	99.22	....	....	....	....	....	....
144		1907	69.24	67.55	57.85	9.70	1.69	69.24	....	....	....	....	....	....
145		1902	63.21	62.36	55.19	7.17	0.85	63.21	....	....	....	....	....	....
146	Colorado	1912	467.97	429.36	348.43	80.93	38.61	434.68	11.68	[7] 3.50	8.18	54.07	30.64	23.43
147		1907	317.37	295.11	206.36	88.75	22.26	317.37	2.18	2.18	....	....	....	....
148		1902	234.53	223.53	154.17	69.36	11.00	232.98	1.55	1.55	....	....	....	....
149	New Mexico	1912	10.60	10.00	10.00	....	0.60	10.60	....	....	....	....	....	....
150		1907	10.10	9.40	9.40	....	0.70	10.10	....	....	....	....	....	....
151		1902	2.10	2.00	2.00	....	0.10	2.10	....	....	....	....	....	....
152	Arizona	1912	46.24	45.32	44.19	1.13	0.92	46.24	....	....	....	....	....	....
153		1907	30.75	29.42	28.42	1.00	1.33	30.75	....	....	....	....	....	....
154		1902	17.10	16.00	15.00	1.00	1.10	17.10	....	....	....	....	....	....
155	Idaho	1912	88.93	87.83	87.83	....	1.10	12.39	76.54	76.54	....	....	....	....
156		1907	44.24	43.00	43.00	....	1.24	44.24	....	....	....	....	....	....
157		1902	3.50	3.33	3.33	....	0.17	3.50	....	....	....	....	....	....
158	Wyoming	1912	22.91	20.80	20.80	....	2.11	22.91	....	....	....	....	....	....
159	Nevada	1912	11.27	10.73	10.73	....	0.54	11.27	....	....	....	0.50	0.50	....
160		1907	7.15	7.00	7.00	....	0.15	7.15	....	....	....	....	....	....
161	Utah	1912	260.18	239.66	189.61	50.05	20.52	260.18	....	....	....	....	....	....
162		1907	122.54	116.28	82.79	33.49	6.26	114.79	7.75	7.75	....	....	....	....
163		1902	89.04	88.20	58.00	30.20	0.84	89.04	....	....	....	....	....	....
	PACIFIC:													
164	Washington	1912	1,035.92	923.16	739.07	184.09	112.76	[8] 1,015.47	39.71	[9] 39.71	....	24.90	19.47	5.43
165		1907	764.73	689.34	563.48	125.86	75.39	744.80	19.93	13.74	6.19	12.17	12.17	....
166		1902	228.93	211.53	181.89	29.64	17.40	228.93	....	....	....	....	....	....
167	Oregon	1912	544.64	463.59	389.11	74.48	81.05	544.64	....	....	....	9.59	9.59	....
168		1907	253.41	228.35	169.28	59.07	25.06	253.41	....	....	....	....	....	....
169		1902	136.67	131.30	94.40	36.90	5.37	136.67	....	....	....	3.81	3.81	....
170	California	1912	2,605.28	2,382.24	1,765.83	616.41	223.04	[10] 2,498.74	99.78	60.27	39.51	46.81	13.83	32.98
171		1907	2,013.49	1,902,91	1,264.10	638.81	110.58	2,002.81	263.02	263.02	....	5.36	5.36	....
172		1902	829.10	819.95	551.40	268.55	9.15	829.10	....	....	....	10.85	10.85	....

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[1] Includes 5 miles leased to steam road.
[2] Leased from a bridge company.
[3] Includes 2 miles not operated.
[4] Includes 0.58 mile not operated.
[5] Includes 1.06 miles not operated.

DIVISIONS AND STATES: 1912, 1907, AND 1902—Continued.

CLASSIFIED ACCORDING TO MOTIVE POWER.																
Electric.					Cable.	Animal.	Steam.	Other.	Surface.	Elevated.	Subway and tunnels.	City and suburban lines.	Interurban lines.	On public thoroughfares.	On private right of way.	
Total.	Line transmission.			Other.												
	Overhead trolley.	Third rail.	Conduit trolley.													
428.53	428.53	...	...	...	...	...	...	12.10	440.63	...	...	375.31	65.32	351.56	89.07	114
351.28	351.28	...	...	...	...	2.90	...	...	354.18	...	...	...	...	279.40	74.78	115
296.63	296.63	...	...	...	...	3.75	...	...	300.38	...	...	...	...	266.39	33.99	116
152.59	152.59	...	...	...	...	...	...	12.25	164.84	...	...	149.84	15.00	110.06	54.78	117
117.13	117.13	...	...	...	...	1.13	...	...	118.26	...	...	...	...	86.10	32.16	118
57.00	57.00	...	...	...	...	4.75	...	...	61.75	...	...	...	...	61.38	0.37	119
493.21	493.21	...	...	...	...	...	...	...	493.21	...	...	366.31	126.90	313.25	179.96	120
389.13	389.13	...	...	...	...	...	...	...	389.13	...	...	...	...	269.64	119.49	121
283.95	283.95	...	...	...	...	...	...	...	283.95	...	...	...	...	253.53	30.42	122
369.31	369.31	...	...	...	0.97	...	...	...	369.98	...	0.30	342.40	27.88	313.99	56.29	123
296.62	296.62	...	...	...	0.88	...	...	...	297.50	...	...	...	...	273.80	23.70	124
248.40	248.40	...	...	...	1.80	...	4.00	...	254.20	...	...	...	...	235.04	19.16	125
306.63	306.63	...	...	...	...	...	...	...	306.63	...	...	306.63	...	216.04	90.59	126
280.66	280.66	...	...	...	...	...	11.00	...	291.66	...	...	...	...	194.56	97.10	127
173.69	173.69	...	...	...	...	3.03	28.00	...	204.72	...	...	...	...	134.39	70.33	128
116.26	116.26	...	...	...	0.39	0.49	...	...	117.14	...	...	108.06	9.08	97.92	19.22	129
86.40	86.40	...	...	...	...	...	...	...	86.40	...	...	...	...	79.96	6.44	130
25.30	25.30	...	...	...	...	...	...	...	25.30	...	...	...	...	24.56	0.74	131
121.94	121.94	...	...	...	...	0.98	...	...	122.92	...	...	122.92	...	118.45	4.47	132
86.41	86.41	...	...	...	...	0.98	...	...	87.39	...	...	...	...	86.67	0.72	133
49.83	49.83	...	...	...	...	2.66	...	...	52.49	...	...	...	...	51.39	1.10	134
285.10	285.10	...	...	...	...	...	...	...	285.10	...	...	271.60	13.50	257.09	28.01	135
238.52	238.52	...	...	...	...	...	...	...	238.52	...	...	...	...	226.64	11.88	136
192.86	192.86	...	...	...	...	5.66	...	...	198.52	...	...	...	...	193.96	4.56	137
251.56	251.56	...	...	...	...	...	...	...	251.56	...	...	143.06	108.50	119.77	131.79	138
100.44	100.44	...	...	...	...	...	...	...	100.44	...	...	...	...	69.76	30.68	139
704.45	704.45	...	...	...	...	4.70	...	7.50	716.65	...	...	516.92	199.73	521.17	195.48	140
405.82	405.82	...	...	...	...	6.80	...	2.25	414.87	...	...	...	...	359.87	55.00	141
296.40	296.40	...	...	...	...	6.87	...	...	303.27	...	...	...	...	249.87	53.40	142
99.22	99.22	...	...	...	...	...	...	...	99.22	...	...	91.34	7.88	75.53	23.69	143
69.24	69.24	...	...	...	...	...	...	...	69.24	...	...	...	...	53.86	15.38	144
63.21	63.21	...	...	...	...	...	...	...	63.21	...	...	...	...	54.79	8.42	145
467.97	467.97	...	...	...	...	...	...	...	467.97	...	...	333.92	134.05	315.42	152.55	146
317.37	317.37	...	...	...	...	...	...	...	317.37	...	...	...	...	261.18	56.19	147
233.28	233.28	...	...	...	...	1.25	...	...	234.53	...	...	...	...	223.66	10.87	148
10.60	10.60	...	...	...	...	...	...	...	10.60	...	...	9.50	1.10	10.35	0.25	149
10.10	10.10	...	...	...	...	...	...	...	10.10	...	...	...	...	9.85	0.25	150
...	...	...	...	...	...	2.10	...	...	2.10	...	...	...	...	2.10	...	151
46.24	46.24	...	...	...	...	...	...	...	46.24	...	...	28.82	17.42	24.54	21.70	152
30.75	30.75	...	...	...	...	...	...	...	30.75	...	...	...	...	22.75	8.00	153
12.00	12.00	...	...	...	...	5.10	...	...	17.10	...	...	...	...	14.10	3.00	154
88.93	88.93	...	...	...	...	...	...	...	88.93	...	...	20.14	68.79	17.09	71.84	155
44.24	44.24	...	...	...	...	...	...	...	44.24	...	...	...	...	14.44	29.80	156
3.50	3.50	...	...	...	...	...	...	...	3.50	...	...	...	...	3.50	...	157
22.91	22.91	...	...	...	...	...	...	...	22.91	...	...	11.91	11.00	11.91	11.00	158
11.27	11.27	...	...	...	...	...	...	...	11.27	...	...	3.30	7.97	11.27	...	159
7.15	7.15	...	...	...	...	...	...	...	7.15	...	...	...	...	6.49	0.66	160
254.05	254.05	...	...	...	...	...	6.13	...	260.18	...	...	170.44	89.74	216.55	43.63	161
122.54	122.54	...	...	...	...	...	...	...	122.54	...	...	...	...	119.74	2.80	162
89.04	89.04	...	...	...	...	...	...	...	89.04	...	...	...	...	88.66	0.38	163
1,026.31	963.30	63.01	...	...	9.61	...	...	...	1,035.92	...	...	608.04	427.88	617.39	418.53	164
743.64	693.23	50.41	...	...	15.04	...	6.05	...	764.73	...	...	...	...	410.82	353.91	165
214.33	214.33	...	...	...	14.60	...	...	...	228.93	...	...	...	...	141.33	87.60	166
521.03	521.03	...	...	...	...	...	23.61	...	543.85	...	0.79	243.24	301.40	254.90	289.74	167
252.39	252.39	...	...	...	...	1.02	...	...	253.41	...	...	...	...	166.47	86.94	168
132.17	132.17	...	...	...	2.00	...	2.50	...	136.67	...	...	...	...	116.51	20.16	169
2,564.12	2,369.33	194.79	...	...	34.05	...	...	7.11	2,604.98	...	0.30	1,509.84	1,095.44	1,386.70	1,218.58	170
1,973.99	1,859.29	114.70	...	...	35.04	4.46	...	...	2,013.49	...	...	...	...	1,296.65	716.84	171
665.96	665.96	...	...	...	85.72	42.37	35.05	...	829.10	...	...	...	...	752.64	76.46	172

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[6] Includes 8.51 miles leased from operating companies.

[7] Includes 1.82 miles leased from operating companies.

[8] Includes 1.46 miles not operated.

[9] Includes 0.18 mile not operated and 23.05 miles leased from operating companies.

[10] Includes 26.22 miles leased to steam roads.

Table 154.—ROLLING STOCK—CARS (NUMBER AND KIND) AND ELECTRIC LOCOMOTIVES, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902.

DIVISION AND STATE.	Census.	CARS.				Cars equipped with motors.	Electric locomotives.
		Total.	Revenue cars.		Service cars: Work cars, snowplows, sweepers, etc.		
			Passenger.	Express, freight, mail, and baggage.			
UNITED STATES	1912	94,016	76,162	7,794	10,060	[1] 73,779	277
	1907	83,641	70,016	5,669	7,956	63,517	117
	1902	66,784	60,290	1,114	5,380	50,699	3
GEOGRAPHIC DIVISIONS:							
New England	1912	13,845	11,618	340	1,887	12,788	22
	1907	12,774	10,756	355	1,663	9,049	15
	1902	11,500	9,979	205	1,316	10,569	......
Middle Atlantic	1912	30,507	26,821	635	3,051	24,690	39
	1907	27,884	24,623	850	2,411	23,754	19
	1902	23,263	21,340	241	1,682	18,627	......
East North Central	1912	21,686	16,286	2,756	2,644	15,530	56
	1907	20,282	16,307	1,877	2,098	13,709	21
	1902	15,758	14,146	352	1,260	9,386	2
West North Central	1912	6,405	5,291	513	601	5,258	32
	1907	5,300	4,652	191	457	4,365	10
	1902	4,954	4,497	79	378	3,699	......
South Atlantic	1912	6,923	6,061	349	513	5,524	11
	1907	6,002	5,414	232	356	4,887	3
	1902	4,604	4,290	128	186	3,746	1
East South Central	1912	2,675	2,286	115	274	2,130	3
	1907	2,361	2,104	53	204	1,918	2
	1902	1,970	1,802	26	142	1,444	......
West South Central	1912	2,493	2,246	29	218	2,136	5
	1907	1,816	1,697	15	104	1,559	1
	1902	1,279	1,205	6	68	1,050	......
Mountain	1912	1,526	1,064	240	222	916	10
	1907	1,030	800	109	121	737	5
	1902	690	619	10	61	571	......
Pacific	1912	7,956	4,489	2,817	650	4,807	99
	1907	6,192	3,663	1,987	542	3,539	41
	1902	2,766	2,412	67	287	1,607	......
NEW ENGLAND:							
Maine	1912	794	519	80	195	570	8
	1907	658	484	63	111	490	8
	1902	598	476	33	89	469	......
New Hampshire	1912	368	304	4	60	347	2
	1907	363	303	4	56	304	1
	1902	287	244	2	41	234	......
Vermont	1912	155	119	8	28	137	2
	1907	159	126	11	22	112	......
	1902	105	80	7	18	90	......
Massachusetts	1912	9,116	7,877	121	1,118	8,447	5
	1907	8,873	7,612	91	1,170	5,952	2
	1902	8,310	7,275	94	941	7,801	......
Rhode Island	1912	1,219	976	84	159	1,120	5
	1907	1,171	952	87	132	812	4
	1902	820	708	21	91	762	......
Connecticut	1912	2,193	1,823	43	327	2,167	......
	1907	1,550	1,279	99	172	[2] 1,379	......
	1902	1,380	1,196	48	136	1,213	......
MIDDLE ATLANTIC:							
New York	1912	18,073	16,095	428	1,550	14,177	30
	1907	15,813	14,251	425	1,137	13,002	12
	1902	14,040	12,978	181	881	10,222	......
New Jersey	1912	3,061	2,697	7	357	2,600	1
	1907	2,930	2,565	13	352	2,832	4
	1902	2,165	1,942	9	214	1,955	......
Pennsylvania	1912	9,373	8,029	200	1,144	7,913	8
	1907	9,141	7,807	412	922	7,920	3
	1902	7,058	6,420	51	587	6,450	......
EAST NORTH CENTRAL:							
Ohio	1912	6,283	5,122	366	795	5,172	16
	1907	5,690	4,774	305	611	4,296	6
	1902	4,395	3,975	44	376	3,188	......
Indiana	1912	2,408	1,612	328	468	1,546	6
	1907	1,699	1,374	84	241	1,393	2
	1902	1,146	998	8	140	818	......
Illinois	1912	8,843	6,272	1,917	654	5,777	28
	1907	9,330	7,260	1,384	686	5,469	10
	1902	7,778	7,021	251	506	3,315	2
Michigan	1912	2,822	2,268	138	416	2,119	3
	1907	2,382	1,945	98	339	1,660	2
	1902	1,757	1,531	48	178	1,466	......
Wisconsin	1912	1,330	1,012	7	311	916	3
	1907	1,181	954	6	221	891	1
	1902	682	621	1	60	599	......
WEST NORTH CENTRAL:							
Minnesota	1912	1,139	1,044	27	68	1,080	......
	1907	754	720	2	32	736	1
	1902	1,083	1,026	......	57	814	......
Iowa	1912	1,465	962	398	105	828	22
	1907	1,080	853	140	87	704	5
	1902	858	675	41	142	535	......
Missouri	1912	2,683	2,325	27	331	2,429	7
	1907	2,557	2,270	27	260	2,242	3
	1902	2,484	2,305	27	152	1,932	......
North Dakota	1912	64	57	......	7	34	......
	1907	52	48	......	4	26	......
South Dakota	1912	29	25	......	4	25	......
	1907	5	3	......	2	3	......
	1902	2	2	......	......	......	......
Nebraska	1912	548	490	10	48	485	2
	1907	518	483	3	32	441	......
	1902	295	282	1	12	271	......
Kansas	1912	477	388	51	38	377	1
	1907	334	275	19	40	213	1
	1902	232	207	10	15	147	......
SOUTH ATLANTIC:							
Delaware	1912	200	183	1	16	200	......
	1907	212	197	1	14	208	......
	1902	163	151	......	12	155	......
Maryland	1912	2,186	1,892	163	131	1,690	......
	1907	1,754	1,586	76	92	1,685	......
	1902	1,589	1,487	42	60	1,533	......
District of Columbia	1912	1,454	1,353	8	93	1,021	2
	1907	1,259	1,190	7	62	808	1
	1902	1,010	977	4	29	638	......
Virginia	1912	946	794	33	119	763	1
	1907	1,072	915	71	86	749	1
	1902	681	626	25	30	461	......
West Virginia	1912	537	473	24	40	461	1
	1907	448	415	10	23	364	......
	1902	287	272	3	12	276	......
North Carolina	1912	325	279	24	22	270	2
	1907	229	197	5	27	191	1
	1902	131	99	25	7	84	1
South Carolina	1912	276	214	45	17	225	4
	1907	189	176	4	9	169	......
	1902	135	123	6	6	106	......

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[1] Includes 21 gasoline-motor cars.

[2] Revised to exclude idle motor equipment.

Table 154.—ROLLING STOCK—CARS (NUMBER AND KIND) AND ELECTRIC LOCOMOTIVES, BY GEOGRAPHIC DIVISIONS AND STATES, 1912, 1907, AND 1902—Continued.

DIVISION AND STATE.	Census.	CARS. Total.	CARS. Revenue cars. Passenger.	CARS. Revenue cars. Express, freight, mail, and baggage.	CARS. Service cars: Work cars, snowplows, sweepers, etc.	Cars equipped with motors.	Electric locomotives.
South Atlantic—Con.							
Georgia	1912	730	645	29	56	667	1
	1907	618	549	33	36	532	......
	1902	497	454	17	26	408	......
Florida	1912	269	228	22	19	227	......
	1907	221	189	25	7	181	......
	1902	111	101	6	4	85	......
East South Central:							
Kentucky	1912	1,010	850	30	130	879	......
	1907	879	808	11	60	750	......
	1902	976	889	2	85	704	......
Tennessee	1912	872	806	2	64	722	1
	1907	747	684	5	58	649	......
	1902	575	555	3	17	470	......
Alabama	1912	596	475	55	66	388	......
	1907	596	488	35	73	405	......
	1902	370	311	21	38	233	......
Mississippi	1912	197	155	28	14	141	2
	1907	139	124	2	13	114	2
	1902	49	47	......	2	37	......
West South Central:							
Arkansas	1912	287	250	4	33	236	1
	1907	212	202	1	9	182	......
	1902	135	130	2	3	89	......
Louisiana	1912	747	681	2	64	722	......
	1907	631	599	1	31	556	......
	1902	670	626	......	44	595	......
Oklahoma	1912	300	257	8	35	226	3
	1907	146	117	8	21	112	1
Texas	1912	1,159	1,058	15	86	952	1
	1907	827	779	5	43	709	......
	1902	474	449	4	21	366	......
Mountain:							
Montana	1912	160	139	1	20	128	......
	1907	126	108	4	14	96	......
	1902	109	90	9	10	79	......
Colorado	1912	785	551	163	71	460	2
	1907	631	474	98	59	418	1
	1902	393	352	1	40	345	......
New Mexico	1912	11	10	......	1	11	......
	1907	13	12	1	......	13	1
	1902	8	8	......	......	......	......
Arizona	1912	41	37	......	4	35	......
	1907	27	27	......	......	24	......
	1902	19	17	......	2	12	......
Idaho	1912	42	37	3	2	41	......
	1907	28	22	6	......	23	......
	1902	3	3	......	......	3	......
Wyoming	1912	22	20	......	2	12	......
Nevada	1912	11	9	......	2	11	......
	1907	7	6	......	1	7	......
Utah	1912	454	261	73	120	218	8
	1907	198	151	......	47	156	3
	1902	158	149	......	9	132	......
Pacific:							
Washington	1912	1,904	976	816	112	1,336	28
	1907	1,762	791	837	134	719	19
	1902	431	312	14	105	268	......
Oregon	1912	1,400	722	494	184	662	22
	1907	670	466	179	25	433	7
	1902	279	250	5	24	200	......
California	1912	4,652	2,791	1,507	354	2,809	49
	1907	3,760	2,406	971	383	2,387	15
	1902	2,056	1,850	48	158	1,139	......

Table 155.—ROLLING STOCK—CARS (NUMBER, KIND, AND EQUIPMENT IN DETAIL)

	DIVISION AND STATE.	CARS.									
		Aggregate number.	Revenue.								
			Total.	Passenger.					Included with passenger.		Express, freight, mail, and baggage.
				Total.	Closed.	Open.	Combination.		Prepayment.	Parlor, sleeping, dining, and private.	
							Closed and open.	Passenger with baggage, express, freight, or mail.			
1	UNITED STATES	94,016	83,956	76,162	48,123	18,993	7,985	1,061	16,012	149	7,794
	GEOGRAPHIC DIVISIONS:										
2	New England	13,845	11,958	11,618	5,479	5,580	535	24	104	10	340
3	Middle Atlantic	30,507	27,456	26,821	17,381	6,498	2,725	217	5,471	19	635
4	East North Central	21,686	19,042	16,286	12,185	3,064	511	526	4,815	64	2,756
5	West North Central	6,405	5,804	5,291	4,342	758	147	44	2,046	11	513
6	South Atlantic	6,923	6,410	6,061	3,195	1,921	867	78	971	9	319
7	East South Central	2,675	2,401	2,286	1,558	493	208	27	912	2	115
8	West South Central	2,493	2,275	2,246	1,580	323	330	13	628	2	29
9	Mountain	1,526	1,304	1,064	454	176	413	21	28	3	240
10	Pacific	7,956	7,306	4,489	1,949	180	2,249	111	1,037	29	2,817
	NEW ENGLAND:										
11	Maine	794	599	519	223	260	35	1		2	80
12	New Hampshire	368	308	304	139	164	1				4
13	Vermont	155	127	119	55	55	6	3			8
14	Massachusetts	9,116	7,998	7,877	3,650	3,731	487	9	104	8	121
15	Rhode Island	1,219	1,060	976	525	447		4			84
16	Connecticut	2,193	1,866	1,823	887	923	6	7			43
	MIDDLE ATLANTIC:										
17	New York	18,073	16,523	16,095	9,810	3,590	2,587	108	2,290	16	428
18	New Jersey	3,061	2,704	2,697	1,960	716	15	6	1,113	2	7
19	Pennsylvania	9,373	8,229	8,029	5,611	2,192	123	103	2,068	1	200
	EAST NORTH CENTRAL:										
20	Ohio	6,283	5,488	5,122	3,267	1,259	352	244	1,241	19	366
21	Indiana	2,408	1,940	1,612	845	550	1	216	47	3	328
22	Illinois	8,843	8,189	6,272	5,539	685	21	27	2,791	32	1,917
23	Michigan	2,822	2,406	2,268	1,649	470	127	22	477	7	138
24	Wisconsin	1,330	1,019	1,012	885	100	10	17	259	3	7
	WEST NORTH CENTRAL:										
25	Minnesota	1,139	1,071	1,044	1,026	11		7	6	1	27
26	Iowa	1,465	1,360	962	629	302	7	24	162	1	398
27	Missouri	2,683	2,352	2,325	2,021	177	123	4	1,513	9	27
28	North Dakota	64	57	57	21	35		1			
29	South Dakota	29	25	25	11	5	9				
30	Nebraska	548	500	490	353	134		3	271		10
31	Kansas	477	439	388	281	94	8	5	94		51
	SOUTH ATLANTIC:										
32	Delaware	200	184	183	90	80	10	3	10		1
33	Maryland	2,186	2,055	1,892	593	574	696	29	185	6	163
34	District of Columbia	1,454	1,361	1,353	902	451			416		8
35	Virginia	946	827	794	513	218	47	16	173	2	33
36	West Virginia	537	497	473	265	157	25	26	2		24
37	North Carolina	325	303	279	149	120	10		8		24
38	South Carolina	276	259	214	167	36	9	2	33		45
39	Georgia	730	674	645	423	157	64	1	100	1	29
40	Florida	269	250	228	93	128	6	1	44		22
	EAST SOUTH CENTRAL:										
41	Kentucky	1,010	880	850	599	80	146	25	426	2	30
42	Tennessee	872	808	806	530	269	7		435		2
43	Alabama	596	530	475	353	110	12		4		55
44	Mississippi	197	183	155	76	34	43	2	47		28
	WEST SOUTH CENTRAL:										
45	Arkansas	287	254	250	123	75	50	2	62		4
46	Louisiana	747	683	681	647	24	9	1		2	2
47	Oklahoma	300	265	257	151	66	32	8	72		8
48	Texas	1,159	1,073	1,058	659	158	239	2	494		15
	MOUNTAIN:										
49	Montana	160	140	139	98	38	3		15		1
50	Colorado	785	714	551	88	72	387	4	8	3	163
51	New Mexico	11	10	10	7		2	1			
52	Arizona	41	37	37	10	9	15	3			
53	Idaho	42	40	37	26	1	3	7			3
54	Wyoming	22	20	20	16	4			5		
55	Nevada	11	9	9	9						
56	Utah	454	334	261	200	52	3	6			73
	PACIFIC:										
57	Washington	1,904	1,792	976	630	16	285	45	131	4	816
58	Oregon	1,400	1,216	722	574	112	16	20	140	6	494
59	California	4,652	4,298	2,791	745	52	1,948	46	766	19	1,507

AND ELECTRIC LOCOMOTIVES, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

CARS—continued.													Electric locomotives.	
Service cars: Work cars, snowplows, sweepers, etc.	Cars classified according to equipment.													
	Brakes.		Motors: number of cars equipped with—									Cable.		
			Electric motors.						Included with preceding.		Gasoline motors.			
	Hand brakes exclusively.	Other types of brakes, including air brakes.	Total.	One motor.	Two motors.	Three motors.	Four motors.	More than four motors.	Storage battery.	Gas-electric.				
10,060	40,304	53,360	73,758	1,207	45,996	749	25,784	22	98	9	21	268	277	1
1,887	8,080	5,758	12,786	960	7,364	9	4,449	4	....	....	2	....	22	2
3,051	13,327	17,085	24,690	70	17,882	565	6,163	10	92	....	....	18	39	3
2,644	7,107	14,445	15,527	41	8,416	113	6,951	6	....	....	3	4	56	4
601	1,931	4,457	5,258	5	2,222	9	3,022	....	....	9	....	9	32	5
513	4,832	2,031	5,518	30	4,210	42	1,236	....	6	....	6	2	11	6
274	1,653	998	2,130	20	1,466	6	638	....	....	....	....	26	3	7
218	1,675	814	2,131	37	1,749	....	345	....	....	....	5	....	5	8
222	474	1,045	916	22	465	5	422	2	....	....	....	....	10	9
650	1,225	6,727	4,802	22	2,222	....	2,558	....	....	....	5	209	99	10
195	553	241	570	2	342	....	226	....	....	....	....	....	8	11
60	160	208	347	30	167	3	145	2	....	....	....	....	2	12
28	102	53	137	....	95	....	42	....	....	....	....	....	2	13
1,118	5,942	3,167	8,445	927	5,191	6	2,319	2	....	....	2	....	5	14
159	476	743	1,120	1	501	....	618	....	....	....	....	....	5	15
327	847	1,346	2,167	....	1,068	....	1,099	....	....	....	....	....	....	16
1,550	8,512	9,489	14,177	40	11,452	447	2,229	9	88	....	....	....	30	17
357	1,286	1,773	2,600	11	1,020	6	1,563	....	....	....	....	....	1	18
1,144	3,529	5,823	7,913	19	5,410	112	2,371	1	4	....	....	18	8	19
795	2,319	3,941	5,172	16	3,108	30	2,012	6	....	....	....	4	16	20
468	1,042	1,347	1,546	5	1,002	21	518	....	....	....	....	....	6	21
654	2,459	6,379	5,774	14	2,362	58	3,340	....	....	....	3	....	28	22
416	489	2,246	2,119	3	1,691	3	422	....	....	....	....	....	3	23
311	798	532	916	3	253	1	659	....	....	....	....	....	3	24
68	124	1,006	1,080	2	77	1	1,000	....	....	9	....	4	....	25
105	617	848	828	....	614	....	214	....	....	....	....	....	22	26
331	548	2,127	2,429	2	780	5	1,642	....	....	....	....	5	7	27
7	62	2	34	....	31	2	1	....	....	....	....	....	....	28
4	29	....	25	....	24	....	1	....	....	....	....	....	....	29
48	267	281	485	....	414	....	71	....	....	....	....	....	2	30
38	284	193	377	1	282	1	93	....	....	....	....	....	1	31
16	174	26	200	....	191	....	9	....	1	....	....	....	....	32
131	1,452	734	1,690	....	1,091	1	598	....	1	....	....	....	....	33
93	1,265	189	1,020	2	863	23	132	....	1	....	1	....	2	34
119	522	401	763	....	593	4	166	....	....	....	....	2	1	35
40	237	294	461	....	309	....	152	....	....	....	....	....	1	36
22	272	53	270	1	232	14	23	....	....	....	....	....	2	37
17	263	12	225	21	172	....	32	....	3	....	....	....	4	38
56	497	231	663	3	573	....	87	....	....	....	4	....	1	39
19	150	91	226	3	186	....	37	....	....	....	1	....	....	40
130	633	377	879	18	549	1	311	....	....	....	....	....	....	41
64	576	296	722	....	547	....	175	....	....	....	....	2	1	42
66	332	264	388	2	254	....	132	....	....	....	....	....	....	43
14	112	61	141	....	116	5	20	....	....	....	....	21	2	44
33	214	72	236	5	216	....	15	....	....	....	....	....	1	45
64	517	229	722	8	692	....	22	....	....	....	....	....	....	46
35	185	113	226	1	167	....	58	....	....	....	....	....	3	47
86	759	400	947	23	674	....	250	....	....	....	5	....	1	48
20	37	123	128	5	97	1	25	....	....	....	....	....	....	49
71	223	555	460	12	209	4	233	2	....	....	....	....	2	50
1	11	....	11	....	10	....	1	....	....	....	....	....	....	51
4	22	19	35	3	25	....	7	....	....	....	....	....	....	52
2	10	32	41	....	14	....	27	....	....	....	....	....	....	53
2	13	9	12	....	8	....	4	....	....	....	....	....	....	54
2	4	7	11	2	9	....	....	....	....	....	....	....	....	55
120	154	300	218	....	93	....	125	....	....	....	....	....	8	56
112	518	1,386	1,336	2	233	....	1,101	....	....	....	....	77	28	57
184	89	1,311	662	....	515	....	147	....	....	....	....	....	22	58
354	618	4,030	2,804	20	1,474	....	1,310	....	....	....	5	132	49	59

Table 156.—TRAFFIC STATISTICS—PASSENGERS, CAR MILEAGE, AND CAR HOURS,

	DIVISION AND STATE.	Census.	Number of operating companies.	Miles of track operated.	NUMBER OF PASSENGERS CARRIED.			
					Total.	Revenue.	Transfer.	Free.
1	UNITED STATES	1912	[1] 975	[1] 41,064.82	12,135,341,716	9,545,554,667	2,423,918,024	165,869,025
2		1907	[2] 945	[2] 34,381.51	9,533,080,766	7,441,114,508	1,995,658,101	96,308,157
3		1902	[3] 817	[3] 22,572.52	5,836,615,296	4,774,211,904	1,062,403,392	([4])
	GEOGRAPHIC DIVISIONS:							
4	New England	1912	91	5,294.55	1,380,035,701	1,051,161,737	311,827,039	17,046,925
5		1907	121	4,874.04	1,135,157,592	875,115,527	254,470,689	5,571,376
6		1902	141	4,008.32	805,313,496	642,546,759	162,766,737	....
7	Middle Atlantic	1912	246	10,043.03	4,125,221,246	3,513,720,591	577,219,067	34,281,588
8		1907	249	8,829.98	3,512,933,679	2,839,019,161	645,301,252	28,613,266
9		1902	220	6,152.10	2,331,783,405	1,975,982,220	355,801,185	....
10	East North Central	1912	222	11,809.69	2,968,575,745	2,159,620,746	756,840,810	52,114,189
11		1907	220	10,335.97	2,140,712,142	1,607,894,497	509,117,585	23,700,060
12		1902	181	6,074.60	1,247,083,945	991,335,624	255,748,321	....
13	West North Central	1912	85	3,098.62	1,063,762,274	787,301,146	264,945,769	11,515,359
14		1907	73	2,508.36	829,769,949	615,630.852	206,192,666	7,946,431
15		1902	[5] 60	[5] 1,740.72	460,458,235	352,665,327	107,792,908	....
16	South Atlantic	1912	107	2,962.28	791,277,464	616,724,741	163,321,953	11,230,770
17		1907	101	2,294.23	622,578,893	487,981,528	125,024,241	9,573,134
18		1902	80	1,670.15	375,902,496	297,198,541	78,703,955	....
19	East South Central	1912	45	1,287.26	342,143,945	268,785,533	66,038,851	7,319,561
20		1907	40	1,064.69	280,303,039	220,887,485	53,235,642	6,129,912
21		1902	34	768.17	134,029,544	117,841,573	16,187,971	....
22	West South Central	1912	79	1,376.23	330,702,628	270,745,675	53,552,763	6,404,190
23		1997	50	841.22	223,797,205	193,338,141	27,030,374	3,428,690
24		1902	32	554.28	100,286,371	92,262,288	8,024,083	....
25	Mountain	1912	40	1,007.32	185,383,120	154,224,248	27,730,485	3,428,387
26		1907	28	601.39	139,506,114	113,304,063	23,906,697	2,295,354
27		1902	20	409.48	74,231,588	61,908,903	12,322,685	....
28	Pacific	1912	60	4,185.84	948,239,593	723,270,250	202,441,287	22,528,056
29		1907	63	3,031.63	648,322,153	487,943,254	151,328,955	9,049,944
30		1902	49	1,194.70	307,526,216	242,470,669	65,055,547	....
	NEW ENGLAND:							
31	Maine	1912	16	536.38	53,184,598	47,049,038	5,008,992	1,126,568
32		1907	17	424.06	40,657,875	36,730,146	3,787,891	139,838
33		1902	19	331.55	27,506,582	25,495,164	2,011,418	....
34	New Hampshire	1912	13	246.26	26,651,471	23,673,362	2,708,290	269,819
35		1907	16	247.10	22,020,103	20,086,690	1,704,139	229,274
36		1902	7	167.65	12,234,120	11,304,908	929,212	....
37	Vermont	1912	9	102.85	8,761,648	8,135,725	517,841	108,082
38		1907	10	124.31	7,460,680	7,103,082	357,598	....
39		1902	9	80.55	4,561,523	4,274,806	286,717	....
40	Massachusetts	1912	43	3,010.48	974,688,684	705,918,383	257,021,576	11,748,725
41		1907	63	2,877.50	814,586,310	597,469,848	213,574,726	3,541,736
42		1902	75	2,521.18	605,258,939	461,745,615	143,513,324	....
43	Rhode Island	1912	2	395.71	109,378,667	94,085,390	13,924,508	1,368,769
44		1907	6	419.92	104,273,001	91,171,989	11,589,102	1,511,910
45		1902	8	328.90	62,394,165	62,279,165	115,000	....
46	Connecticut	1912	8	1,002.87	207,370,633	172,299,839	32,645,832	2,424,962
47		1907	9	781.15	146,159,623	122,553,772	23,457,233	148,618
48		1902	23	578.49	93,358,167	77,447,101	15,911.066	....
	MIDDLE ATLANTIC:							
49	New York	1912	101	4,605.44	2,473,872,433	2,126,964,018	336,017,654	10,890,761
50		1907	101	3,884.74	2,123,242,239	1,657,686,801	455,906,610	9,648,828
51		1902	96	2,809.91	1,424,915,703	1,144,491,509	280,424,194	....
52	New Jersey	1912	24	1,319.85	452,964,664	356,858,007	86,315,721	9,790,936
53		1907	26	1,324.12	345,202,599	269,099,070	69,329,479	6,774,050
54		1902	26	861.28	228,082,103	188,976,899	39,105,204	....
55	Pennsylvania	1912	121	4,117.74	1,198,384,149	1,029,898,566	154,885,692	13,599,891
56		1907	122	3,621.12	1,044,488,841	912,233,290	120,065,163	12,190,388
57		1902	98	2,480.91	678,785,599	642,513,812	36,271,787	....
	EAST NORTH CENTRAL:							
58	Ohio	1912	75	4,069.12	814,481,364	632,332,134	172,227,558	9,921,672
59		1907	73	3,762.69	608,599,567	480,843,805	122,195,401	5,560,361
60		1902	63	2,353.43	356,788,221	285,434,579	71,353,642	....
61	Indiana	1912	34	2,301.34	211,469,425	173,019,238	33,462,108	4,988,079
62		1907	33	1,932.93	169,110,331	137,547,183	27,277,769	4,285,379
63		1902	27	646.66	80,974,221	66,255,767	14,718,454	....
64	Illinois	1912	67	3,125.84	1,395,234,949	932,667,608	435,752,683	26,814,658
65		1907	70	2,774.67	993,589,254	703,493,137	283,335,431	6,760,686
66		1902	50	1,635.20	590,598,228	463,190,986	127,407,242	....
67	Michigan	1912	22	1,507.26	371,396,806	286,955,619	75,170,049	9,271,138
68		1907	24	1,275.03	237,073,769	183,239,012	47,410,475	6,424,282
69		1902	24	1,022.81	140,440,783	113,916,992	26,523,791	....
70	Wisconsin	1902	24	806.13	175,993,201	134,646,147	40,228,412	1,118,612
71		1907	20	590.65	132.339.221	102,771,360	28,898,509	669,352
72		1902	17	416.50	78,282,492	62,537,300	15,745,192	....

[1] Includes 2 companies representing 18.51 miles of track operated, carrying freight only.
[2] Includes 1 company representing 15 miles of track operated, carrying freight only.
[3] Includes 6 companies representing 80.14 miles of track operated, which failed to furnish passenger statistics, or carried freight only.

BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902.

REVENUE CAR MILES.			COMPANIES REPORTING REVENUE CAR HOURS.					AVERAGE NUMBER OF REVENUE PASSENGERS—			
Total.	Passenger cars.	Express, mail, and freight cars.	Number of companies.	Revenue passengers carried.	Revenue car hours.			Per mile of track.	Per revenue passenger car mile.	Per revenue passenger car hour.	
					Total number.	Passenger cars.	Express, mail, and freight cars.				
1,921,620,074	1,885,870,157	35,749,917	899	9,075,785,815	190,478,140	187,590,223	2,887,917	232,556	5.06	48.38	1
1,617,731,300	1,583,831,199	33,900,101	734	6,401,840,576	151,338,944	148,678,052	2,660,892	216,522	4.70	43.06	2
1,144,430,466	1,120,101,944	24,328,522	390	2,176,886,559	65,869,342	65,403,287	466,055	212,259	4.26	33.28	3
191,451,066	188,554,259	2,896,807	85	1,045,799,694	19,639,455	19,264,804	374,651	198,536	5.57	54.28	4
176,730,085	173,312,851	3,417,234	81	673,592,890	14,348,466	14,005,608	342,858	179,546	5.05	48.09	5
145,300,636	142,910,777	2,389,859	83	520,109,110	14,214,264	14,058,245	156,019	160,358	4.50	37.00	6
663,588,817	658,874,277	4,714,540	236	3,442,612,865	67,971,951	67,276,969	694,982	349,867	5.33	51.17	7
571,192,811	564,980,273	6,212,538	199	2,739,389,151	60,836,678	60,261,185	575,493	321,520	5.02	45.46	8
420,186,221	402,570,447	17,615,774	68	171,882,189	5,899,909	5,879,870	20,039	321,188	4.91	29.23	9
474,239,256	461,620,512	12,618,744	196	1,854,265,520	40,806,316	39,797,448	1,008,868	183,142	4.68	46.59	10
403,817,479	392,858,725	10,958,754	172	1,225,717,593	32,614,702	31,557,393	1,057,309	155,789	4.09	38.84	11
274,890,992	272,763,594	2,127,398	94	762,512,703	22,106,603	21,963,057	143,546	163,773	3.63	34.72	12
152,346,875	150,077,714	2,269,161	83	786,475,592	16,355,142	16,115,252	239,890	254,081	5.25	48.80	13
127,231,467	126,069,386	1,162,081	54	592,237,640	13,203,237	13,080,025	123,212	245,432	4.88	45.28	14
91,956,441	91,363,621	592,820	31	312,959,874	8,286,197	8,232,507	53,690	207,484	3.86	38.02	15
124,591,004	122,989,023	1,601,981	95	600,168,042	14,201,550	13,967,241	234,309	208,193	5.01	42.97	16
105,825,575	104,955,444	870,131	85	273,563,022	7,277,269	7,190,075	87,194	212,699	4.65	38.05	17
80,327,931	79,409,639	918,292	43	125,519,466	4,038,197	4,023,199	14,998	179,258	3.74	31.20	18
58,056,424	57,462,686	593,738	40	265,607,299	6,538,414	6,477,336	61,078	208,947	4.68	41.01	19
49,264,244	48,577,842	686,402	35	167,080,195	4,421,298	4,340,440	80,858	207,466	4.55	38.49	20
32,692,996	32,553,960	139,036	22	80,213,017	4,634,747	4,596,158	38,589	153,406	3.62	17.45	21
61,616,556	61,086,645	529,911	76	266,688,939	7,020,648	6,970,848	49,800	196,730	4.43	38.26	22
46,122,447	45,464,447	658,000	41	189,930,142	5,097,144	5,052,162	44,982	229,831	4.25	37.59	23
30,543,662	30,489,844	53,818	21	80,875,281	3,173,219	3,164,941	8,278	166,454	3.03	25.55	24
30,149,835	29,897,485	252,350	35	108,340,232	2,361,962	2,352,578	9,384	153,104	5.16	46.05	25
23,372,469	22,978,762	393,707	15	69,168,514	1,537,628	1,503,245	34,383	188,404	4.93	46.01	26
13,859,274	13,817,794	41,480	7	38,974,727	1,002,814	1,002,814	....	152,711	4.48	38.86	27
165,580,241	155,307,556	10,272,685	53	705,827,632	15,582,702	15,367,747	214,955	172,790	4.66	45.93	28
114,174,723	104,633,469	9,541,254	52	471,161,429	12,002,522	11,687,919	314,603	160,951	4.66	40.31	29
54,672,313	54,222,268	450,045	21	83,840,192	2,513,392	2,482,496	30,896	202,955	4.47	33.77	30
11,124,224	10,550,279	573,945	15	47,045,303	1,140,928	1,057,073	83,855	87,716	4.46	44.51	31
9,074,069	8,802,670	271,399	12	20,994,682	554,707	517,402	37,305	86,615	4.17	40.58	32
6,815,671	6,389,750	425,921	14	12,510,845	456,023	379,444	76,579	76,897	3.99	32.97	33
4,726,181	4,705,228	20,953	13	23,673,362	495,171	492,591	2,580	96,132	5.03	48.06	34
4,776,654	4,656,629	120,025	12	17,310,221	443,367	414,050	29,317	81,290	4.31	41.81	35
3,214,879	3,214,611	268	3	5,241,124	161,145	161,145	....	67,432	3.52	32.52	36
1,776,244	1,727,407	48,837	6	4,311,514	100,890	98,340	2,550	79,103	4.71	43.84	37
1,810,853	1,771,987	38,866	4	993,148	37,003	35,763	1,240	57,140	4.01	27.77	38
1,412,528	1,288,965	123,563	3	959,210	47,981	45,164	2,817	53,070	3.32	21.24	39
125,893,579	125,062,538	831,041	41	704,384,286	12,744,981	12,617,068	127,913	234,487	5.64	55.83	40
118,671,549	117,168,135	1,503,414	40	532,280,812	11,281,728	11,065,616	216,112	207,635	5.10	48.10	41
101,373,975	100,115,307	1,258,668	46	428,550,827	11,287,251	11,244,744	42,507	182,822	4.61	38.11	42
15,085,155	14,731,612	353,543	2	94,085,390	1,759,107	1,718,345	40,762	237,763	6.39	54.75	43
15,737,978	15,335,805	402,173	5	90,715,622	1,782,707	1,729,046	53,661	217,118	5.95	52.47	44
12,296,893	12,173,911	122,982	1	651,276	36,500	29,200	7,300	189,356	5.12	22.30	45
32,845,683	31,777,195	1,068,488	8	172,299,839	3,398,378	3,281,387	116,991	171,807	5.42	52.51	46
26,658,982	25,577,625	1,081,357	8	11,298,405	248,954	243,731	5,223	156,889	4.79	46.36	47
20,186,690	19,728,233	458,457	16	72,195,828	2,225,364	2,198,548	26,816	134,194	3.93	32.84	48
411,007,777	408,691,799	2,315,978	100	2,068,884,824	39,241,635	38,840,011	401,624	461,837	5.20	53.27	49
336,783,703	332,506,950	4,276,753	93	1,651,300,284	35,767,445	35,295,886	471,559	426,718	4.99	46.78	50
251,312,176	234,279,043	17,033,133	10	34,793,948	1,520,117	1,507,367	12,750	407,305	4.89	23.08	51
60,994,398	60,929,169	65,229	23	355,865,814	6,788,325	6,781,275	7,050	270,378	5.86	52.48	52
55,658,531	55,029,951	628,580	15	243,076,632	5,443,917	5,442,097	1,820	203,229	4.89	44.67	53
35,372,346	35,355,733	16,613	7	19,794,395	700,478	697,838	2,640	219,414	5.35	28.36	54
191,586,642	189,253,309	2,333,333	113	1,017,862,227	21,941,991	21,655,683	286,308	250,113	5.44	47.00	55
178,750,577	177,443,372	1,307,205	91	845,012,235	19,625,316	19,523,202	102,114	251,920	5.14	43.28	56
133,501,699	132,935,671	566,028	51	117,293,846	3,679,314	3,674,665	4,649	258,983	4.83	32.16	57
137,547,824	132,444,038	5,103,786	63	350,683,512	9,188,940	8,818,031	370,909	155,398	4.77	39.77	58
124,480,321	120,596,365	3,883,956	52	292,606,535	8,114,202	7,843,695	270,507	127,793	3.99	37.30	59
83,996,438	83,135,144	861,294	26	145,116,450	4,642,564	4,595,702	46,862	121,284	3.43	31.58	60
47,879,465	45,720,000	2,159,465	30	169,281,584	4,201,242	4,004,263	196,979	75,182	3.78	42.28	61
41,369,611	39,504,604	1,865,007	26	132,470,502	3,923,040	3,734,879	188,161	71,160	3.48	35.47	62
21,095,357	20,931,788	163,569	24	35,719,137	1,535,344	1,522,321	13,023	102,458	3.17	23.46	63
201,026,579	197,750,090	3,276,489	64	918,406,869	18,669,459	18,479,732	189,727	300,066	4.72	49.70	64
170,332,063	166,646,747	3,685,316	60	643,214,662	16,687,877	16,149,124	538,753	254,919	4.22	39.83	65
121,142,474	120,835,074	307,400	20	430,296,986	12,014,959	11,990,052	24,907	287,035	3.83	35.81	66
61,189,274	59,233,006	1,956,268	20	285,317,588	6,126,437	5,885,373	241,064	190,382	4.84	48.48	67
45,836,200	44,388,125	1,448,075	17	57,737,109	1,656,057	1,607,346	48,711	143,713	4.13	35.92	68
33,046,839	32,333,464	713,375	11	92,325,111	2,325,843	2,267,089	58,754	111,376	3.52	40.72	69
26,596,114	26,473,378	122,736	19	130,575,967	2,620,238	2,610,049	10,189	167,028	5.09	50.03	70
21,799,284	21,722,884	76,400	17	99,688,785	2,233,526	2,222,349	11,177	173,997	4.73	44.86	71
15,609,884	15,528,124	81,760	13	59,055,019	1,587,893	1,587,893	....	150,150	4.03	37.19	72

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[4] Not reported separately.

[5] Includes 1 company in South Dakota with 2 miles of track operated, which failed to furnish passenger statistics.

Table 156.—TRAFFIC STATISTICS—PASSENGERS, CAR MILEAGE, AND CAR HOURS,

	DIVISION AND STATE.	Census.	Number of operating companies.	Miles of track operated.	NUMBER OF PASSENGERS CARRIED.			
					Total.	Revenue.	Transfer.	Free.
	WEST NORTH CENTRAL:							
73	Minnesota	1912	9	555.18	249,490,524	186,918,421	61,611,666	960,437
74		1907	5	457.15	175,451,502	136,122,311	39,158,456	170,735
75		1902	5	338.17	90,698,793	73,236,612	17,462,181	....
76	Iowa	1912	24	803.87	109,450,938	93,417,773	13,117,251	2,915,914
77		1907	24	639.84	73,611,748	61,439,860	11,114,440	1,057,448
78		1902	22	378.25	44,076,534	38,559,589	5,516,945	....
79	Missouri	1912	19	996.00	575,813,719	402,209,826	167,213,033	6,390,860
80		1907	14	921.67	492,716,513	346,361,741	140,454.246	5,900,526
81		1902	16	758.38	290,092,823	211,808,737	78,284,086	....
82	North Dakota	1912	3	26.02	3,078,958	2,861,707	195,391	21,860
83		1907	4	16.09	2,105,860	1,871,994	233,866	....
84	South Dakota	1912	2	21.59	1,748,284	1,656,744	81,711	9,829
85		1907	1	5.00	125,515	125,515	....	....
86	Nebraska	1912	7	243.80	82,867,589	64,709,312	17,570,540	587,737
87		1907	8	218.73	61,731,806	49,323,051	11,975,339	433,416
88		1902	4	113.66	27,619,504	22,228,325	5,391,179	....
89	Kansas	1912	21	452.16	41,312,262	35,527,363	5,156,177	628,722
90		1907	17	249.88	24,027,005	20,386,380	3,256,319	384,306
91		1902	12	150.26	7,970,581	6,832,064	1,138,517	....
	SOUTH ATLANTIC:							
92	Delaware	1912	4	90.37	21,881,379	18,023,562	3,498,863	358,954
93		1907	4	95.93	19,282,805	15,723,757	3,227,211	331,837
94		1902	3	85.61	11,440,702	9,956,559	1,484,143	....
95	Maryland	1912	14	692.51	259,978,572	186,828,016	69,914,407	3,236,149
96		1907	13	536.18	211,402,192	152,268,326	55,614,404	3,519,462
97		1902	10	437.84	135,625,650	99,989,552	35,636,098	....
98	District of Columbia	1912	7	214.23	153,887,045	114,099,618	39,078,631	708,796
99		1907	6	176.03	130,490,524	91,569,056	38,439,924	481,544
100		1902	8	161.97	90,203,941	66,162,321	24,041,620	....
101	Virginia	1912	18	561.86	114,601,299	91,980,005	20,704,367	1,916,927
102		1907	23	515.54	88,614,999	77,300,268	9,531,818	1,782,913
103		1902	21	359.30	52,369,902	44,275,661	8,094,241	....
104	West Virginia	1912	21	404.98	56,226,800	52,841,464	2,334,154	1,051,182
105		1907	15	265.41	44,616,042	42,749,821	1,183,122	683,099
106		1902	8	140.00	22,183,794	21,706,870	476,924	....
107	North Carolina	1912	13	190.26	25,500,960	21,241,446	3,605,985	653,529
108		1907	11	106.44	15,858,622	14,086,151	1,652,848	119,623
109		1902	7	46.32	6,783,695	5,337,367	1,446,328	....
110	South Carolina	1912	6	202.60	21,567,797	17,872,934	2,894,271	800,592
111		1907	7	131.26	18,277,936	15,694,635	2,104,371	478,930
112		1902	7	76.98	10,748,724	9,056,818	1,691,906	....
113	Georgia	1912	14	440.63	103,592,240	86,601,456	15,180,307	1,810,477
114		1907	12	349.18	71,820,439	59,700,459	10,154,556	1,965,424
115		1902	10	300.38	37,004,361	32,463,851	4,540,510	....
116	Florida	1912	10	164.84	34,041,372	27,236,240	6,110,968	694,164
117		1907	10	118.26	22,215,334	18,889,055	3,115,987	210,292
118		1902	6	61.75	9,541,727	8,249,542	1,292,185	....
	EAST SOUTH CENTRAL:							
119	Kentucky	1912	10	493.21	132,217,034	103,512,260	26,903,064	1,801,710
120		1907	13	389.13	107,798,494	85,858,931	20,545,140	1,394,423
121		1902	12	283.95	61,683,130	56,293,852	5,389,278	....
122	Tennessee	1912	12	370.28	122,188,294	91,896,498	27,368,078	2,923,718
123		1907	9	297.50	99,268,212	73,746,986	22,829,867	2,691,359
124		1902	8	254.20	45,476,511	35,697,835	9,778,676	....
125	Alabama	1912	11	306.63	74,889,350	62,493,698	10,321,925	2,073,727
126		1907	10	291.66	62,923,421	52,197,482	8,842,346	1,883,593
127		1902	9	204.72	23,741,963	22,748,871	993,092	....
128	Mississippi	1912	12	117.14	12,849,267	10,883,077	1,445,784	520,406
129		1907	8	86.40	10,312,912	9,084,086	1,068,289	160,537
130		1902	5	25.30	3,127,940	3,101,015	26,925	....
	WEST SOUTH CENTRAL:							
131	Arkansas	1912	10	122.92	28,168,102	24,304,436	3,072,453	791,213
132		1907	8	87.39	20,916,339	17,145,387	3,078,670	692,282
133		1902	7	52.49	7,835,569	6,880,479	955,090	....
134	Louisiana	1912	13	285.10	117,037,478	94,052,645	21,355,874	1,628,959
135		1907	11	238.52	94,785,724	85,193,632	8,045,350	1,546,742
136		1902	8	198.52	60,285,120	55,343,843	4,941,277	....
137	Oklahoma	1912	17	251.56	25,491,981	22,120,519	2,982,221	389,241
138		1907	8	100.44	11,089,973	9,502,472	1,563,932	23,569
139	Texas	1912	39	716.65	160,005,067	130,268,075	26,142,215	3,594,777
140		1907	23	414.87	97,005,169	81,496,650	14,342,422	1,166,097
141		1902	17	303.27	32,165,682	30,037,966	2,127,716	....

BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902—Continued.

REVENUE CAR MILES.			COMPANIES REPORTING REVENUE CAR HOURS.					AVERAGE NUMBER OF REVENUE PASSENGERS—			
					Revenue car hours.						
Total.	Passenger cars.	Express, mail, and freight cars.	Number of companies.	Revenue passengers carried.	Total number.	Passenger cars.	Express, mail, and freight cars.	Per mile of track.	Per revenue passenger car mile.	Per revenue passenger car hour.	
32,793,134	32,687,433	105,701	9	186,918,421	3,518,409	3,509,023	9,386	336,681	5.72	53.27	73
24,370,694	24,370,694	....	5	136,122,311	2,691,665	2,691,665	....	297,763	5.59	50.57	74
15,692,887	15,692,887	....	5	73,236,612	1,699,868	1,699,868	....	216,567	4.67	43.08	75
22,122,185	20,908,972	1,213,213	23	92,998,963	2,479,980	2,404,551	75,429	116,210	4.47	38.68	76
17,128,619	16,647,266	481,353	19	59,891,661	1,931,989	1,895,247	36,742	96,024	3.69	31.60	77
11,809,254	11,688,888	120,366	11	29,924,683	1,121,902	1,118,252	3,650	101,942	3.30	26.76	78
72,573,075	72,094,357	478,718	19	402,209,826	7,713,425	7,625,733	87,692	403,825	5.58	52.74	79
69,137,991	68,615,923	522,068	10	336,851,227	7,098,256	7,015,863	82,393	375,798	5.05	48.01	80
55,762,991	55,326,272	436,719	7	205,971,707	5,261,037	5,210,997	50,040	279,291	3.83	39.53	81
660,451	657,058	3,393	3	2,861,707	89,525	87,804	1,721	109,981	4.36	32.59	82
389,218	389,218	....	4	1,871,994	61,558	61,558	....	116,345	4.81	30.41	83
474,292	474,292	....	1	1,250,000	35,600	35,600	....	76,737	3.49	35.11	84
48,600	48,600	....	1	125,515	3,312	3,312	....	25,103	2.58	37.90	85
12,613,274	12,414,530	198,744	7	64,709,312	1,372,853	1,349,078	23,775	265,420	5.21	47.97	86
10,356,712	10,248,974	107,738	7	49,299,051	1,135,978	1,132,741	3,237	225,497	4.81	43.52	87
6,273,945	6,238,210	35,735	....	....	....	....	....	195,569	3.56	....	88
11,110,464	10,841,072	269,392	21	35,527,363	1,145,350	1,103,463	41,887	78,573	3.28	32.20	89
5,799,633	5,748,711	50,922	8	8,075,881	280,479	279,639	840	81,585	3.55	28.88	90
2,417,364	2,417,364	....	8	3,826,872	203,390	203,390	....	61,406	2.83	18.82	91
3,967,217	3,957,461	9,756	4	18,023,562	647,298	643,176	4,122	199,442	4.55	28.02	92
4,013,211	3,991,161	22,050	4	15,723,757	489,797	486,197	3,600	163,909	3.94	32.34	93
3,006,798	2,969,238	37,560	1	7,905,086	236,520	236,520	....	116,301	3.35	33.42	94
34,438,526	33,810,936	627,590	12	184,739,227	3,995,687	3,886,016	109,671	269,784	5.53	47.54	95
29,351,027	28,963,767	387,260	9	9,057,717	249,354	246,136	3,218	283,987	5.26	36.80	96
24,832,662	24,238,490	594,172	5	1,793,292	67,517	67,283	234	228,370	4.13	26.65	97
18,558,418	18,554,716	3,702	7	114,099,618	2,182,633	2,182,352	281	532,603	6.15	52.28	98
19,385,292	19,377,792	7,500	5	50,581,076	1,068,718	1,068,718	....	520,190	4.73	47.33	99
16,139,141	16,082,204	56,937	7	37,799,756	889,767	883,763	6,004	408,485	4.11	42.77	100
19,902,981	19,541,487	361,494	16	90,206,115	2,231,537	2,190,609	40,928	163,706	4.71	41.18	101
18,096,351	17,960,718	135,633	22	76,085,516	2,052,114	2,027,567	24,547	149,940	4.30	37.53	102
12,335,072	12,304,104	30,968	18	41,723,913	1,536,137	1,527,377	8,760	127,562	3.60	27.32	103
11,706,784	11,507,300	199,484	21	52,841,464	1,255,465	1,217,884	37,581	130,479	4.59	43.39	104
8,296,777	8,247,777	49,000	11	21,632,707	550,914	545,646	5,268	161,071	5.18	39.65	105
6,734,171	6,734,171	....	4	3,996,475	156,171	156,171	....	155,049	3.22	25.59	106
5,997,546	5,890,872	106,674	10	16,061,771	571,655	563,475	8,180	111,644	3.61	28.50	107
3,868,204	3,809,645	58,559	9	12,393,199	422,293	408,183	14,110	132,339	3.70	30.36	108
1,676,978	1,629,299	47,679	1	1,160,519	51,610	51,610	....	115,228	3.28	22.49	109
4,657,872	4,644,233	13,639	4	14,730,360	514,501	513,301	1,200	88,218	3.85	28.70	110
3,825,478	3,805,370	20,108	7	15,694,635	440,218	436,618	3,600	119,569	4.12	35.95	111
2,520,231	2,502,844	17,387	2	1,315,212	49,418	49,418	....	117,652	3.62	26.61	112
19,217,358	19,013,795	203,563	13	85,145,417	2,105,217	2,079,915	25,302	196,540	4.55	40.94	113
14,600,261	14,488,830	111,431	9	54,037,305	1,486,796	1,472,260	14,536	170,973	4.12	36.70	114
10,733,429	10,690,826	42,603	3	26,250,493	925,416	925,416	....	108,076	3.04	28.37	115
6,144,302	6,068,223	76,079	8	24,320,508	697,557	690,513	7,044	165,228	4.49	35.22	116
4,388,974	4,310,384	78,590	9	18,357,110	517,065	498,750	18,315	159,725	4.38	36.81	117
2,349,449	2,258,463	90,986	2	3,574,720	125,641	125,641	....	133,596	3.65	28.45	118
22,274,394	21,998,513	275,881	8	101,423,145	2,376,057	2,370,419	5,638	209,875	4.71	42.79	119
18,750,421	18,345,627	404,794	10	34,594,077	946,637	914,715	31,922	220,643	4.68	37.82	120
15,477,507	15,451,572	25,935	9	39,694,486	3,006,531	3,003,976	2,555	198,253	3.64	13.21	121
18,935,984	18,898,337	37,647	11	91,533,893	2,216,241	2,216,063	178	248,181	4.86	41.30	122
15,928,762	15,884,612	44,150	9	73,746,986	1,867,141	1,857,382	9,759	247,889	4.64	39.70	123
10,138,603	10,134,919	3,684	4	16,594,974	783,405	779,755	3,650	140,432	3.52	21.28	124
13,313,450	13,041,770	271,680	10	62,269,135	1,564,752	1,510,780	53,972	203,808	4.79	41.22	125
11,785,298	11,554,680	230,618	10	52,197,482	1,360,911	1,321,734	39,177	178,967	4.52	39.49	126
6,152,896	6,043,479	109,417	6	21,508,671	761,719	729,335	32,384	111,122	3.76	29.49	127
3,532,596	3,524,066	8,530	11	10,381,126	381,364	380,074	1,290	93,610	3.09	27.31	128
2,799,763	2,792,923	6,840	6	6,541,650	246,609	246,609	....	105,140	3.25	26.53	129
923,990	923,990	....	3	2,414,886	83,092	83,092	....	122,570	3.36	29.06	130
5,593,487	5,585,314	8,173	9	24,303,786	655,993	655,261	732	197,726	4.35	37.09	131
4,331,294	4,329,034	2,260	5	16,036,189	442,725	439,355	3,370	196,194	3.96	36.50	132
2,144,776	2,144,196	580	....	....	....	....	....	131,082	3.21	....	133
21,812,319	21,794,369	17,950	13	94,052,645	2,484,356	2,482,663	1,693	329,894	4.32	37.88	134
20,506,652	20,174,162	332,490	9	83,783,967	2,183,074	2,182,974	100	357,176	4.22	38.38	135
18,594,869	18,594,869	....	8	55,343,843	2,025,648	2,025,648	....	278,782	2.98	27.32	136
6,142,726	6,104,686	38,040	15	18,064,433	596,470	588,792	7,678	87,933	3.62	30.68	137
2,479,202	2,460,668	18,534	8	9,502,472	297,968	289,368	8,600	94,608	3.86	32.84	138
28,068,024	27,602,276	465,748	39	130,268,075	3,283,829	3,244,132	39,697	181,774	4.72	40.15	139
18,805,299	18,500,583	304,716	19	80,607,514	2,173,377	2,140,465	32,912	196,439	4.41	37.66	140
9,804,017	9,750,779	53,238	13	25,531,438	1,147,571	1,139,293	8,278	99,047	3.08	22.41	141

TABLE 156.—TRAFFIC STATISTICS—PASSENGERS, CAR MILEAGE, AND CAR HOURS,

	DIVISION AND STATE.	Census.	Number of operating companies.	Miles of track operated.	NUMBER OF PASSENGERS CARRIED.			
					Total.	Revenue.	Transfer.	Free.
	MOUNTAIN:							
142	Montana	1912	6	99.22	17,430,364	15,351,219	1,605,849	473,296
143		1907	5	69.24	14,089,649	13,862,231	145,231	82,187
144		1902	5	63.21	6,917,002	6,858,502	58,500	....
145	Colorado	1912	16	467.97	107,502,972	86,597,205	18,813,014	2,092,753
146		1907	11	317.37	93,683,653	73,458,468	18,362,433	1,862,752
147		1902	8	234.53	52,327,717	42,371,590	9,956,127	....
148	New Mexico	1912	2	10.60	1,040,367	951,347	77,000	12,020
149		1907	2	10.10	1,074,598	1,029,048	27,300	18,250
150		1902	1	2.10	73,000	73,000	....	....
151	Arizona	1912	4	46.24	4,762,518	4,553,831	126,354	82,333
152		1907	4	30.75	2,058,861	1,901,861	128,000	29,000
153		1902	2	17.10	799,710	797,970	1,740	....
154	Idaho	1912	3	88.93	4,600,507	4,169,451	276,204	154,852
155		1907	2	44.24	1,507,335	1,326,964	157,246	23,125
156		1902	1	3.50	314,340	314,340	....	....
157	Wyoming	1912	2	22.91	1,412,927	1,399,330	2,647	10,950
158	Nevada	1912	2	11.27	750,000	750,000	....	....
159		1907	1	7.15	661,025	620,000	31,025	10,000
160	Utah	1912	5	260.18	47,883,465	40,451,865	6,829,417	602,183
161		1907	3	122.54	26,430,993	21,105,491	5,055,462	270,040
162		1902	3	89.04	13,799,819	11,493,501	2,306,318	....
	PACIFIC:							
163	Washington	1912	19	1,035.92	163,717,821	126,686,767	30,226,149	6,804,905
164		1907	14	764.73	142,496,001	110,506,620	29,951,966	2,037,415
165		1902	8	228.93	42,533,743	41,544,228	989,515	....
166	Oregon	1912	6	544.64	101,194,838	75,842,324	21,916,726	3,435,788
167		1907	8	253.41	63,930,947	49,459,483	12,146,734	2,324,730
168		1902	6	136.67	23,666,753	18,729,442	4,937,311	....
169	California	1912	35	2,605.28	683,326,934	520,741,159	150,298,412	12,287,363
170		1907	41	2,013.49	441,895,205	327,977,151	109,230,255	4,687,799
171		1902	35	829.10	241,325,720	182,196,999	59,128,721	....

BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902—Continued.

REVENUE CAR MILES.			COMPANIES REPORTING REVENUE CAR HOURS.					AVERAGE NUMBER OF REVENUE PASSENGERS—			
					Revenue car hours.						
Total.	Passenger cars.	Express, mail, and freight cars.	Number of companies.	Revenue passengers carried.	Total number.	Passenger cars.	Express, mail, and freight cars.	Per mile of track.	Per revenue passenger car mile.	Per revenue passenger car hour.	
2,901,249	2,901,249	....	5	6,685,653	170,387	170,387	....	154,719	5.29	39.24	142
2,432,477	2,432,477	....	3	2,995,763	84,337	83,487	850	200,206	5.70	35.88	143
1,354,822	1,313,942	40,880	2	1,288,675	55,070	55,070	....	108,503	5.22	23.40	144
17,202,137	17,162,190	39,947	16	86,597,205	1,770,191	1,766,461	3,730	185,049	5.05	49.02	145
14,596,838	14,297,798	299,040	5	62,793,479	1,294,187	1,262,884	31,303	231,460	5.14	49.72	146
8,925,060	8,924,560	500	3	36,888,082	910,004	910,004	....	183,865	4.75	40.54	147
308,665	308,665	....	2	951,347	34,439	34,439	....	89,750	3.08	27.62	148
249,050	248,450	600	1	760,000	24,090	24,090	....	101,886	4.14	31.55	149
61,320	61,320	....	....	....	....	....	....	34,762	1.19	....	150
1,019,012	1,019,012	....	4	4,553,831	114,784	114,784	....	98,483	4.47	39.67	151
918,054	918,054	....	3	1,793,808	90,155	90,155	....	61,849	2.07	19.90	152
306,600	306,600	....	2	797,970	37,740	37,740	....	46,665	2.60	21.14	153
1,419,984	1,355,667	64,317	3	4,169,451	129,691	125,379	4,312	46,885	3.08	33.25	154
385,965	378,585	7,380	1	154,185	9,889	8,659	1,230	29,995	3.51	17.81	155
164,250	164,250	....	....	....	....	....	....	89,811	1.91	....	156
380,885	380,885	....	2	1,399,330	38,221	38,221	....	61,079	3.67	36.61	157
270,000	270,000	....	....	....	....	....	....	66,548	2.78	....	158
250,000	250,000	....	1	620,000	28,400	27,400	1,000	86,713	2.48	22.63	159
6,647,903	6,499,817	148,086	3	3,983,415	104,249	102,907	1,342	155,476	6.22	38.71	160
4,540,085	4,453,398	86,687	1	51,279	6,570	6,570	....	172,233	4.74	7.81	161
3,047,222	3,047,122	100	....	....	....	....	....	129,082	3.77	....	162
29,516,695	27,096,799	2,419,896	18	114,176,627	2,661,946	2,499,897	162,049	122,294	4.68	45.67	163
24,364,214	22,943,472	1,420,742	14	110,506,620	3,008,217	2,820,150	188,067	144,504	4.82	39.18	164
8,378,420	8,285,417	93,003	7	36,667,399	900,038	876,471	23,567	181,471	5.01	41.84	165
19,509,670	17,792,258	1,717,412	4	73,637,168	1,835,077	1,835,077	....	139,252	4.26	40.13	166
15,025,037	10,470,327	4,554,710	7	49,404,733	1,229,794	1,225,414	4,380	195,176	4.72	40.32	167
4,781,105	4,719,355	61,750	4	12,991,398	480,979	477,379	3,600	137,041	3.97	27.21	168
116,553,876	110,418,499	6,135,377	31	518,013,837	11,085,679	11,032,773	52,906	199,879	4.72	46.95	169
74,785,472	71,219,670	3,565,802	31	311,250,076	7,764,511	7,642,355	122,156	162,890	4.61	40.73	170
41,512,788	41,217,496	295,292	10	34,181,395	1,132,375	1,128,646	3,729	219,753	4.42	30.29	171

TABLE 157.—TRACK AND CAPITALIZATION, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902.

DIVISION AND STATE.	Census.	Number of companies (operating and lessor).	MILES OF TRACK.		CAPITAL STOCK.		DIVIDENDS.		Funded debt.	Total capitalization.	Net capitalization per mile of track.	Floating debt and mortgages.[1]	Interest on funded and floating debt and mortgages.
			Owned.	Operated in division or state.	Common.	Preferred.	Common.	Preferred.					
UNITED STATES....	1912	1,260	[2]40,470.13	41,032.91	$1,970,385,003	$408,961,310	$58,759,715	$12,232,503	$2,329,221,828	$4,708,568,141	$104,930	$302,259,042	$113,259,470
	1907	[3] 1,236	34,121.17	34,353.99	1,776,920,076	320,788,780	44,960,796	9,524,478	1,677,063,240	3,774,772,096	100,495	282,986,902	[4] 41,771,266
	1902	[3] 987	22,524.02	22,568.32	1,187,642,781	127,930,179	28,737,887	4,301,284	992,709,139	2,308,282,099	96,287	....	[5] 46,462,470
GEOGRAPHIC DIVISIONS:													
New England........	1912	119	5,204.74	5,299.02	180,683,350	23,760,250	6,781,098	827,231	129,639,840	334,083,440	61,577	18,495,830	6,478,134
	1907	148	4,882.15	4,862.93	121,650,188	16,570,700	4,526,060	805,719	130,606,958	268,827,846	54,724	15,594,750	5,097,404
	1902	170	4,012.79	4,013.52	99,676,547	10,510,050	3,789,596	512,750	70,264,242	180,450,839	45,441	....	3,357,340
Middlo Atlantic......	1912	436	9,766.21	10,064.31	636,148,840	75,849,537	24,881,763	2,826,011	801,582,533	1,513,580,910	134,702	149,670,176	38,941,696
	1907	452	8,659.12	8,891.06	687,812,324	62,748,400	26,827,066	2,273,713	557,410,106	1,307,970,830	140,724	131,641,236	28,066,718
	1902	345	6,115.68	6,168.14	528,844,490	27,263,117	14,425,379	1,054,005	385,983,823	942,091,430	143,284	....	18,529,293
East North Central...	1912	253	11,768.39	11,883.69	424,192,308	110,111,403	10,930,374	3,644,042	589,361,398	1,123,665,109	87,102	33,995,561	28,151,023
	1907	263	10,312.88	10,353.18	495,874,660	97,821,385	7,451,231	2,036,340	436,565,900	1,030,261,945	87,292	45,807,454	20,809,569
	1902	193	6,061.81	6,148.88	286,850,653	43,717,141	7,324,339	1,001,717	229,597,894	560,165,688	85,122	....	10,052,703
West North Central..	1912	90	3,075.67	3,030.50	120,920,545	38,326,975	2,602,728	734,037	155,092,155	314,339,675	97,807	20,848,481	8,195,624
	1907	77	2,444.67	2,454.61	95,676,045	31,217,300	1,776,837	1,275,155	130,583,800	257,477,145	102,948	20,449,142	5,893,827
	1902	61	1,740.72	1,688,67	90,049,825	24,129,600	1,225,397	1,080,087	94,981,149	209,160,574	106,125	....	1,401,251
South Atlantic.......	1912	123	2,883.36	2,899.75	151,100,605	45,466,900	3,855,777	1,619,593	205,449,168	402,016,673	125,409	13,291,564	8,864,523
	1907	111	2,293.88	2,244.46	106,519,554	20,786,695	1,555,021	660,016	155,785,359	283,091,608	112,013	13,830,582	1,948,272
	1902	82	1,666.39	1,628.90	72,885,900	8,536,271	681,240	66,125	115,091,908	196,514,079	114,289	....	1,702,608
East South Central...	1912	46	1,283.71	1,290.68	43,966,704	13,202,860	1,783,573	676,666	71,296,580	128,466,144	92,051	3,857,068	3,440,406
	1907	40	1,060.42	1,074.75	36,683,080	13,782,200	620,282	541,200	53,758,167	104,223,447	93,925	5,062,860	2,780,485
	1902	34	768.17	762.90	23,964,700	3,850,000	246,000	206,000	28,213,200	56,027,900	70,742	....	1,458,580
West South Central..	1912	83	1,376.56	1,371.80	61,655,778	24,886,427	1,793,975	845,445	65,691,669	152,233,874	93,272	10,536,550	3,741,908
	1907	51	841.22	839.98	48,712,250	20,490,000	859,302	670,335	45,827,950	115,030,200	100,083	8,460,029	1,104,978
	1902	32	554.28	553.13	16,021,100	6,500,000	121,698	263,100	15,020,900	37,542,000	67,405	....	707,016
Mountain............	1912	42	975.71	1,047.52	40,134,552	8,070,175	1,331,000	69,285	46,014,459	94,219,186	77,514	8,891,811	2,625,980
	1907	29	601.39	630.24	25,335,475	5,410,200	316,830	25,824	29,699,600	60,445,275	76,358	3,394,673	1,563,607
	1902	21	409.48	409.48	12,702,517	224,000	184,250	....	12,531,710	25,458,227	58,406	....	219,749
Pacific...............	1912	68	4,135.78	4,145.64	311,582,321	69,286,783	4,799,427	990,193	265,094,026	645,963,130	145,428	42,672,001	12,820,176
	1907	65	3,025.44	3,002.78	158,656,500	51,961,900	1,028,167	1,236,176	136,825,400	347,443,800	102,272	38,746,176	875,200
	1902	49	1,194.70	1,194.70	56,647,049	3,200,000	739,988	117,500	41,024,313	100,871,362	82,761	....	2,131,309
NEW ENGLAND:													
Maine................	1912	17	536.38	530.49	11,591,825	4,450,000	171,359	208,498	19,102,382	35,144,207	52,022	61,998	921,407
	1907	17	424.06	418.12	9,909,713	1,035,000	184,944	1,750	11,039,000	21,983,713	49,481	264,173	425,894
	1902	20	331.55	328.50	5,053,055	....	67,829	....	6,155,000	11,208,055	32,116	....	(6)
New Hampshire......	1912	13	215.54	268.15	4,093,400	70,000	91,755	....	2,322,000	6,485,400	30,065	222,608	111,618
	1907	18	247.10	268.38	4,448,700	70,000	74,170	....	2,589,000	7,107,700	28,764	418,622	(6)
	1902	13	167.65	174.45	2,283,200	50,000	8,250	....	1,556,000	3,889,200	23,198	....	84,515
Vermont.............	1912	9	102.85	120.83	2,824,350	23,750	82,286	861	2,813,558	5,661,658	51,310	259,289	150,315
	1907	10	124.31	113.38	3,370,000	....	18,000	....	2,548,667	5,918,667	41,981	114,840	107,451
	1902	9	80.55	86.05	1,820,100	15,000	8,000	750	931,600	2,766,700	34,348	....	40,662
Massachusetts........	1912	60	3,016.81	2,950.96	83,732,975	10,058,600	3,501,259	168,756	80,728,700	174,520,275	57,786	15,532,123	4,115,136
	1907	82	2,885.61	2,851.11	68,060,175	6,400,000	3,277,689	512,000	60,279,000	134,739,175	46,583	13,455,490	3,352,738
	1902	93	2,525.65	2,503.11	52,978,602	6,400,000	2,670,455	512,000	37,966,942	97,345,544	39,067	....	2,219,926
Rhode Island........	1912	8	385.47	435.37	26,485,500	150,000	1,057,565	100,000	6,523,200	33,158,700	79,037	2,419,812	1,179,658
	1907	9	419.92	430.76	24,355,400	200,000	850,000	....	7,070,200	31,625,600	81,494	1,341,625	1,211,321
	1902	8	328.90	342.92	16,375,000	....	760,000	....	6,221,200	22,596,200	75,979	....	1,012,237
Connecticut..........	1912	12	947.69	993.22	51,955,300	9,007,900	1,876,874	349,116	18,150,000	79,113,200	80,232		
	1907	12	781.15	781.18	11,506,200	8,865,700	121,257	291,969	47,081,091	67,452,991	84,852		
	1902	27	578.49	578.49	21,166,590	4,045,050	275,062	....	17,433,500	42,645,140	74,493		
MIDDLE ATLANTIC:													
New York............	1912	134	4,394.46	4,485.81	354,075,580	34,943,500	17,445,609	1,279,381	481,571,770	870,590,850	185,616	110,443,630	24,352,988
	1907	147	3,719.56	3,809.19	350,482,049	27,565,500	16,317,307	938,126	336,447,138	714,494,687	173,096	77,966,094	16,832,136
	1902	119	2,773.49	2,797.90	270,374,935	5,830,737	6,826,754	54,110	252,929,373	529,135,045	177,532	....	12,241,187
New Jersey..........	1912	43	1,276,34	1,308.97	75,157,176	1,600,000	1,818,375	95,487	94,932,000	171,689,176	131,833	6,338,393	4,569,033
	1907	43	1,324.12	1,319.80	73,176,280	1,035,100	910,398	43,500	86,260,500	160,471,880	135,439	2,282,432	4,205,064
	1902	30	861.28	865.66	67,178,440	995,000	425,140	22,500	57,490,750	125,664,190	148,155	....	2,733,971
Pennsylvania........	1912	259	4,095.41	4,269,53	206,916,084	39,306,037	5,617,779	1,451,143	225,078,763	471,300,884	81,261	32,888,153	10,019,675
	1907	262	3,615.44	3,762,07	264,153,995	34,147,800	9,599,361	1,292,087	134,702,468	433,004,263	109,072	51,392,710	7,029,518
	1902	196	2,480.91	2,504.58	191,291,115	20,437,380	7,173,485	977,395	75,563,70	287,292,195	103,267	....	3,554,135

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[1] Figures for 1902 not available.
[2] Includes 30.73 miles not represented by capitalization, located 23.78 miles in New York, 3.25 miles in Ohio, and 3.70 miles in Texas.
[3] Includes 6 companies in 1907 and 20 companies in 1902 not reporting financial data.
[4] Total includes $13,631,206 interest on funded and floating debt and mortgages of lessor companies not distributed by divisions and states.
[5] Total includes $6,902,621 interest on funded and floating debt and mortgages of lessor companies not distributed by divisions and states.
[6] Figures not available.

Table 157.—TRACK AND CAPITALIZATION, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902—Contd.

DIVISION AND STATE.	Census.	Number of companies (operating and lessor).	MILES OF TRACK.		CAPITAL STOCK.		DIVIDENDS.		Funded debt.	Total capitalization.	Net capitalization per mile of track.	Floating debt and mortgages.[1]	Interest on funded and floating debt and mortgages.
			Owned.	Operated in division or state.	Common.	Preferred.	Common.	Preferred.					
EAST NORTH CENTRAL:													
Ohio	1912	88	4,053.53	3,999.22	$162,629,150	$49,138,300	$3,720,039	$1,292,557	$138,806,040	$350,573,490	$72,196	$13,052,133	$6,897,178
	1907	90	3,760.46	3,671.45	190,033,050	40,812,825	3,114,766	1,039,401	116,289,000	347,134,875	79,901	17,160,503	5,930,019
	1902	67	2,353.43	2,338.50	99,643,650	9,250,000	2,289,554	344,000	61,242,000	170,135,650	71,805	....	2,513,009
Indiana	1912	45	2,296.28	2,323.38	71,742,225	30,203,910	667,937	761,415	89,385,787	191,331,922	78,381	5,334,338	4,281,053
	1907	43	1,927.43	1,928.78	75,830,260	18,393,710	457,160	249,898	72,063,350	166,287,320	82,307	4,019,489	3,258,142
	1902	27	646.66	656.63	15,245,887	1,689,141	....	33,974	23,142,477	40,077,505	[2] 61,976	....	984,391
Illinois	1912	72	3,110.00	3,185.73	129,583,927	21,150,193	4,516,418	1,080,490	256,620,427	407,354,547	127,803	10,697,213	12,280,523
	1907	86	2,759.31	2,753.71	170,358,550	29,795,850	2,516,701	353,928	167,379,400	367,533,800	115,341	19,727,619	7,795,393
	1902	58	1,622.41	1,659.35	134,819,316	25,708,100	4,484,722	261,243	99,558,267	260,085,683	135,507	....	4,361,337
Michigan	1912	23	1,502.45	1,526.25	37,726,506	4,269,000	862,500	223,080	60,111,724	102,107,230	64,083	3,299,366	2,933,972
	1907	24	1,275.03	1,323.71	34,388,400	4,219,000	566,750	120,780	48,625,900	87,233,300	63,288	3,930,016	2,445,809
	1902	24	1,022.81	1,048.26	26,588,100	2,445,000	519,500	92,500	32,596,800	61,629,900	58,233	....	1,547,772
Wisconsin	1912	25	806.13	849.11	22,510,500	5,350,000	1,163,480	286,500	44,437,420	72,297,920	72,716	1,612,511	1,758,297
	1907	20	590.65	675.53	25,264,400	4,600,000	795,854	272,333	32,208,250	62,072,650	71,326	969,827	1,380,206
	1902	17	416.50	446.14	10,553,700	4,624,900	30,563	270,000	13,058,350	28,236,950	66,094	....	646,194
WEST NORTH CENTRAL:													
Minnesota	1912	9	544.35	538.48	26,674,700	5,644,500	1,458,500	210,000	23,580,000	55,899,200	101,370	451,962	1,178,750
	1907	5	457.15	437.82	20,905,000	3,000,000	1,005,000	210,000	20,912,500	44,817,500	95,587	1,554,300	1,122,138
	1902	5	338.17	316.27	18,780,000	4,500,000	600,400	270,000	13,226,000	36,506,000	107,952	....	870,038
Iowa	1912	26	791.41	783.87	23,851,244	4,975,975	565,552	138,806	24,708,900	53,536,119	65,882	5,086,335	1,053,700
	1907	26	581.75	641.39	18,061,846	2,631,200	204,500	15,000	12,804,500	33,497,546	55,070	1,787,921	(3)
	1902	22	378.25	341.35	9,591,200	950,000	107,660	10,000	6,770,333	17,311,533	45,641	....	353,118
Missouri	1912	19	997.51	959.01	40,992,150	18,306,700	227,000	54,600	79,947,200	139,246,050	137,547	14,937,965	4,568,005
	1907	14	917.07	866.68	40,448,749	18,986,200	291,840	727,160	80,836,000	140,270,949	150,217	16,701,747	4,490,780
	1902	17	758.38	713.68	50,354,400	17,979,700	313,337	769,287	71,474,816	139,808,916	152,206	....	(3)
North Dakota	1912	3	26.02	19.18	470,000	....	28,170	....	314,555	784,555	30,152		
	1907	4	16.09	13.66	384,980	....	....	....	300,000	684,980	42,572	60,000	30,805
South Dakota	1912	2	21.59	21.59	490,350	100,000	....	....	200,000	790,350	36,607	95,100	17,761
	1907	1	5.00	5.00	85,000	....	....	....	....	85,000	17,000	....	(4)
	1902	1	2.00	2.00	100,000	....	....	....	....	100,000	50,000		
Nebraska	1912	10	243.80	214.46	13,871,376	7,712,900	286,756	327,082	13,639,000	35,223,276	112,270	108,993	706,956
	1907	10	218.73	184.34	7,664,685	6,199,900	223,037	294,995	9,540,000	23,404,585	106,266	133,503	(3)
	1902	4	113.66	119.56	5,312,225	699,900	200,000	30,800	2,395,000	8,407,125	73,967	....	122,045
Kansas	1912	21	450.99	493.91	14,570,725	1,586,900	36,750	3,549	12,702,500	28,860,125	60,644	203,226	657,408
	1907	17	248.88	305.72	8,125,785	400,000	52,460	28,000	6,190,800	14,716,585	56,917	176,571	263,148
	1902	12	150.26	195.81	5,912,000	....	4,000	....	1,115,000	7,027,000	46,766	....	56,050
SOUTH ATLANTIC:													
Delaware	1912	8	90.37	99.37	8,071,000	600,000	144,600	30,000	1,882,200	10,553,200	97,175		
	1907	7	95.93	104.93	2,732,000	169,995	72,200	....	3,070,000	5,971,995	62,254		
	1902	3	85.61	85.61	2,264,990	....	9,331	....	2,424,000	4,688,990	54,772		
Maryland	1912	17	686.63	719.74	23,662,000	1,654,000	502,475	88,275	71,026,800	96,342,800	135,575	2,962,958	4,111,157
	1907	15	536.18	551.51	17,355,550	55,000	5,000	....	59,009,000	76,419,550	136,923	3,913,625	(3)
	1902	12	437.84	455.44	15,962,700	73,306	4,420	....	52,359,194	68,395,200	156,142	....	(3)
District of Columbia	1912	7	214.23	188.46	21,064,800	8,500,000	980,000	425,000	24,247,468	53,812,268	206,638		
	1907	6	176.03	160.02	22,558,500	8,500,000	720,000	425,000	20,310,709	51,369,209	[2] 291,821		
	1902	8	161.97	146.17	17,543,550	....	602,827	....	9,280,000	26,823,550	165,608		
Virginia	1912	20	498.65	561.49	25,530,600	8,675,000	522,228	398,960	38,125,100	72,330,700	129,178	2,913,272	1,741,853
	1907	24	512.10	512.99	27,746,869	5,925,000	101,750	....	34,770,800	68,442,669	131,231	3,019,184	(3)
	1902	21	355.79	358.17	17,087,000	4,725,000	270	33,125	25,891,314	47,703,314	124,845	....	490,484
West Virginia	1912	24	402.52	330.18	16,140,300	3,480,800	373,425	120,748	18,304,900	37,926,000	82,875	1,273,224	814,766
	1907	18	266.41	207.72	10,924,075	....	26,400	....	10,406,500	21,330,575	70,732	2,923,084	640,172
	1902	8	140.00	93.08	4,273,600	....	22,000	....	5,308,400	9,582,000	[2] 68,443	....	237,812
North Carolina	1912	15	190.26	190.26	13,482,200	2,267,100	92,217	115,784	8,174,000	23,923,300	89,221	1,725,194	405,278
	1907	12	104.53	106.44	3,353,100	1,056,700	17,500	5,000	3,887,750	8,297,550	64,214	1,115,631	(3)
	1902	7	46.07	46.32	1,657,660	337,965	....	....	1,880,500	3,876,125	70,250	....	87,219
South Carolina	1912	7	202.60	228.08	7,332,905	1,640,000	113,725	30,000	4,076,400	13,049,305	59,083	1,987,964	222,820
	1907	7	131.26	131.18	3,384,200	600,000	....	....	4,766,000	8,750,200	56,786	1,330,420	340,706
	1902	7	76.98	76.98	2,489,400	100,000	720	....	3,336,000	5,925,400	[2] 76,973	....	180,392
Georgia	1912	15	445.63	417.33	31,181,200	17,500,000	888,357	354,807	34,248,800	82,930,000	175,785	1,645,158	1,282,834
	1907	12	354.18	351.41	14,360,400	3,750,000	443,771	200,016	16,789,600	34,900,000	88,436	920,638	830,757
	1902	10	300.38	305.38	9,857,600	3,100,000	952	33,000	13,081,500	26,039,100	[2] 86,687	....	644,361
Florida	1912	10	152.47	164.84	4,635,600	1,150,000	238,750	56,019	5,363,500	11,149,100	68,247	783,794	285,815
	1907	10	117.26	118.26	4,104,860	730,000	168,400	30,000	2,775,000	7,609,860	63,942	608,000	136,637
	1902	6	61.75	61.75	1,749,400	200,000	40,720	....	1,531,000	3,480,400	56,363	....	62,340

[1] Figures for 1902 not available.

[2] Gross capitalization without the deduction of permanent or other investments.

[3] Figures not available.

[4] No company reported for North Dakota, and the 1 company in South Dakota, failed to furnish this information.

Table 157.—TRACK AND CAPITALIZATION, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902—Contd.

DIVISION AND STATE.	Census.	Number of companies (operating and lessor).	MILES OF TRACK.		CAPITAL STOCK.		DIVIDENDS.		Funded debt.	Total capitalization.	Net capitalization per mile of track.	Floating debt and mortgages.[1]	Interest on funded and floating debt and mortgages.
			Owned.	Operated in division or state.	Common.	Preferred.	Common.	Preferred.					
EAST SOUTH CENTRAL:													
Kentucky	1912	10	490.02	502.38	$16,341,220	$2,523,810	$1,112,935	$125,000	$20,397,120	$39,262,150	$69,347	$1,171,809	$924,293
	1907	13	385.36	402.34	12,757,400	3,290,000	499,738	126,200	15,726,000	31,773,400	81,454	1,921,019	789,097
	1902	12	283.95	284.35	8,830,900	2,500,000	246,000	125,000	12,204,300	23,535,200	[2] 82,885	....	598,594
Tennessee	1912	12	369.34	360.93	13,701,000	7,000,000	328,888	341,666	28,878,000	49,579,000	130,953	1,084,069	1,418,102
	1907	9	297.50	292.15	10,970,200	6,528,900	79,676	205,000	19,348,000	36,847,100	122,948	1,359,193	1,040,975
	1902	8	254.20	248.53	8,160,400	....	....	....	8,686,400	16,846,800	63,984	....	478,473
Alabama	1912	12	307.21	308.80	9,482,000	3,515,000	341,750	210,000	17,002,500	29,999,500	87,115	1,096,608	834,480
	1907	10	291.16	293.86	9,480,900	3,500,000	40,868	210,000	15,181,667	28,162,567	87,457	1,077,822	741,292
	1902	9	204.72	204.72	6,346,900	1,350,000	....	81,000	6,678,500	14,375,400	65,584	....	347,330
Mississippi	1912	12	117.14	118.57	4,442,484	164,050	....	....	5,018,960	9,625,494	77,316	504,582	263,531
	1907	8	86.40	86.40	3,474,580	463,300	....	....	3,502,500	7,440,380	71,406	704,826	209,121
	1902	5	25.30	25.30	626,500	....	....	....	644,000	1,270,500	[2] 50,217	....	34,183
WEST SOUTH CENTRAL:													
Arkansas	1912	10	122.25	113.72	3,642,893	2,470,227	150,000	139,195	6,552,736	12,665,856	103,135	317,761	374,635
	1907	8	87.39	82.22	3,345,600	1,500,000	60,228	45,000	4,453,000	9,298,600	90,924	687,617	232,720
	1902	7	52.49	51.33	885,300	....	....	....	1,058,000	1,943,300	36,251	....	60,858
Louisiana	1912	15	285.10	285.10	30,016,514	15,436,800	1,024,495	540,250	31,922,750	77,376,064	195,856	2,529,177	1,574,893
	1907	12	238.52	238.52	29,709,700	17,130,000	454,904	544,335	29,145,000	75,984,700	198,631	3,152,754	(3)
	1902	8	198.52	198.52	7,384,900	5,100,000	107,198	255,000	10,010,000	22,494,900	113,313	....	483,594
Oklahoma	1912	18	251.88	251.56	8,299,650	2,544,400	25,215	....	7,151,000	17,995,050	68,608	1,322,711	422,791
	1907	8	100.44	100.44	3,995,800	150,000	150,000	....	2,029,000	6,174,800	59,258	46,000	86,645
Texas	1912	40	717.33	721.42	19,696,721	4,435,000	594,265	166,000	20,065,183	44,196,904	59,305	6,366,901	1,369,589
	1907	23	414.87	418.80	11,661,150	1,710,000	194,170	81,000	10,200,950	23,572,100	55,239	4,573,658	785,613
	1902	17	303.27	303.28	7,750,900	1,400,000	14,500	8,100	3,952,900	13,103,800	[2] 43,208	....	162,564
MOUNTAIN:													
Montana	1912	6	99.22	99.22	2,942,532	690,000	....	30,000	2,514,220	6,146,752	51,727	90,022	116,650
	1907	5	69.24	69.24	2,407,275	374,000	16,830	18,700	1,550,000	4,331,275	39,705	81,418	79,638
	1902	5	63.21	63.21	2,045,613	....	....	....	1,275,000	3,320,613	52,533	....	60,658
Colorado	1912	17	436.36	467.97	23,679,550	1,224,000	1,300,000	39,285	31,280,130	56,183,680	92,981	2,286,520	1,618,029
	1907	11	317.37	317.37	17,112,300	886,200	300,000	7,124	19,450,000	37,448,500	80,686	931,932	1,033,840
	1902	9	234.53	234.53	7,338,804	224,000	181,250	....	8,395,560	15,958,364	68,911	....	(3)
New Mexico	1912	2	10.60	10.60	325,000	....	....	....	191,000	516,000	48,679	6,515,269	891,301
	1907	2	10.10	10.10	450,000	....	....	....	407,000	857,000	84,851	2,381,323	450,129
	1902	1	2.10	2.10	25,000	....	....	....	....	25,000	11,905	....	159,091
Arizona	1912	4	46.24	46.24	3,544,700	320,000	31,000	....	1,414,800	5,279,500	106,872		
	1907	4	30.75	30.75	1,383,400	....	....	....	214,600	1,598,000	51,967		
	1902	2	17.10	17.10	127,800	....	....	....	61,150	188,950	11,050		
Idaho	1912	4	88.93	129.13	4,661,800	1,473,000	....	....	3,139,809	9,274,609	88,834		
	1907	2	44.24	73.09	750,000	150,000	....	....	1,239,000	2,139,000	[2] 48,350		
	1902	1	3.50	3.50	55,300	....	....	....	....	55,300	15,800		
Wyoming	1912	2	22.91	22.91	475,000	....	....	....	420,000	895,000	37,966		
Nevada	1912	2	11.27	11.27	1,044,695	....	....	....	136,000	1,180,695	104,676		
	1907	1	7.15	7.15	1,000,000	....	....	....	130,000	1,130,000	158,042		
Utah	1912	5	260.18	260.18	3,461,275	4,363,175	....	....	6,918,500	14,742,950	55,800		
	1907	4	122.54	122.54	2,232,500	4,000,000	....	....	6,709,000	12,941,500	[2] 105,610		
	1902	3	89.04	89.04	3,110,000	....	3,000	....	2,800,000	5,910,000	[2] 66,375		
PACIFIC:													
Washington	1912	20	1,032.13	991.17	59,829,975	19,489,533	1,904,321	428,193	56,926,500	136,246,008	122,145	12,085,442	2,976,182
	1907	15	758.54	730.27	29,518,000	10,936,900	118,367	438,176	23,414,000	63,868,900	75,702	8,918,612	(3)
	1902	8	228.93	228.93	8,036,400	3,000,000	37,528	112,500	7,747,813	18,784,213	[2] 82,052	....	384,862
Oregon	1912	6	544.64	549.19	24,872,800	354,000	2,322,260	12,000	43,209,776	68,436,576	120,474	10,320,283	2,127,132
	1907	8	253.41	259.02	14,891,400	7,537,500	160,000	375,000	16,599,000	39,027,900	83,202	1,271,764	875,200
	1902	6	136.67	136.67	2,588,550	200,000	49,048	5,000	2,737,000	5,525,550	40,430	....	128,897
California	1912	42	2,559.01	2,605.28	226,879,546	49,443,250	572,846	550,000	164,957,750	441,280,546	160,131	20,266,276	7,716,862
	1907	42	2,013.49	2,013.49	114,247,100	33,487,500	749,800	423,000	96,812,400	244,547,000	114,681	28,555,800	(3)
	1902	35	829.10	829.10	46,022,099	....	653,412	....	30,539,500	76,561,599	90,166	....	1,617,550

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[1] Figures for 1902 not available.

[2] Gross capitalization without the deduction of permanent or other investments.

[3] Figures not available.

TABLE 158.—CONDENSED INCOME ACCOUNT OF OPERATING COMPANIES, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902.

DIVISION AND STATE.	Census.	Number of companies.	Gross income.	OPERATING ACCOUNTS.				Miscellaneous income.	Gross income less operating expenses.	Deductions from income (taxes and fixed charges).	Net income.[1]	Dividends.	Surplus.[1]
				Revenues.	Expenses.	Net revenues.	Per cent ratio; expenses of revenues.						
UNITED STATES	1912	975	$585,930,517	$567,511,704	$332,896,356	$234,615,348	58.7	$18,418,813	$253,034,161	$191,123,408	$61,910,753	$51,650,117	$10,260,636
	1907	[2] 939	429,744,254	418,187,858	251,309,252	166,878,606	60.1	11,556,396	178,435,002	138,094,716	40,340,286	26,454,732	13,885,554
	1902	[3] 799	250,504,627	247,553,999	142,312,597	105,241,402	57.5	2,950,628	108,192,030	77,595,053	30,596,977	15,882,110	14,714,867
GEOGRAPHIC DIVISIONS:													
New England	1912	91	57,423,017	56,515,083	37,316,197	19,198,886	66.0	907,934	20,106,820	14,062,569	6,044,251	5,858,014	186,237
	1907	118	46,751,626	46,420,066	31,471,822	14,948,244	67.8	331,560	15,279,804	11,454,167	3,825,637	2,757,576	1,068,061
	1902	137	33,378,366	33,261,786	22,877,440	10,384,346	68.8	116,580	10,500,926	7,054,630	3,446,296	2,985,951	460,345
Middle Atlantic	1912	246	198,038,906	191,676,824	108,656,704	83,020,120	56.7	6,362,082	89,382,202	75,286,805	14,095,397	14,149,065	*53,668*
	1907	247	150,475,317	147,405,991	84,837,741	62,568,250	57.6	3,069,326	65,637,576	60,453,506	5,184,070	6,715,820	*1,531,750*
	1902	219	99,416,430	97,772,294	53,626,649	44,145,645	54.8	1,644,136	45,789,781	36,046,981	9,742,800	3,833,886	5,908,914
East North Central	1912	222	139,260,473	135,275,159	78,747,118	56,528,041	58.2	3,985,314	60,513,355	45,893,986	14,619,369	11,956,824	2,662,545
	1907	220	101,418,112	99,148,956	60,170,744	38,978,212	60.7	2,269,156	41,247,368	29,409,640	11,837,728	6,557,032	5,280,696
	1902	177	55,887,241	54,962,484	31,105,834	23,856,650	56.6	924,757	24,781,407	16,662,311	8,119,096	4,901,845	3,217,251
West North Central	1912	85	45,179,223	44,881,324	27,363,397	17,517,927	61.0	297,899	17,815,826	11,225,491	6,590,335	3,272,186	3,318,149
	1907	73	33,865,459	33,634,196	18,204,188	15,430,008	54.1	231,263	15,661,271	10,394,107	5,267,164	2,991,392	2,275,772
	1902	58	18,385,649	18,322,764	10,165,628	8,157,136	55.5	62,885	8,220,021	6,306,643	1,913,378	1,536,197	377,181
South Atlantic	1912	107	41,368,967	39,458,505	21,591,731	17,866,774	54.7	1,910,462	19,777,236	13,277,195	6,500,041	4,449,464	2,050,577
	1907	100	29,604,986	28,531,988	16,280,864	12,251,124	57.1	1,072,998	13,324,122	7,998,784	5,325,338	2,139,337	3,186,001
	1902	75	15,164,235	14,989,177	8,186,047	6,803,130	54.6	175,058	6,978,188	5,260,379	1,717,809	746,945	970,864
East South Central	1912	45	17,562,259	17,084,483	9,867,378	7,217,105	57.8	477,776	7,694,881	4,727,566	2,967,315	2,460,239	507,076
	1907	40	13,646,689	13,403,737	8,070,391	5,333,346	60.2	242,952	5,576,298	3,763,689	1,812,609	1,161,482	651,127
	1902	34	6,556,640	6,555,741	3,709,854	2,845,887	56.6	899	2,846,786	1,796,235	1,050,551	452,000	598,551
West South Central	1912	79	18,853,761	17,030,510	10,390,837	6,639,673	61.0	1,823,251	8,462,924	5,139,540	3,323,384	2,414,420	908,964
	1907	50	12,706,325	11,144,894	6,816,880	4,328,014	61.2	1,561,431	5,889,445	3,195,729	2,693,716	1,525,096	1,168,620
	1902	32	4,829,650	4,829,650	2,969,022	1,860,628	61.5	....	1,860,628	957,934	902,694	384,798	517,896
Mountain	1912	40	11,950,736	11,102,619	6,426,225	4,676,394	57.9	848,117	5,524,511	3,729,066	1,795,445	1,400,285	395,160
	1907	28	7,699,393	7,175,900	4,099,483	3,076,417	57.1	523,493	3,599,910	1,911,327	1,688,583	342,654	1,345,929
	1902	18	3,332,777	3,307,014	2,039,948	1,267,066	61.7	25,763	1,292,829	787,361	505,468	183,000	322,468
Pacific	1912	60	56,293,175	54,487,197	32,536,769	21,950,428	59.7	1,805,978	23,756,406	17,781,190	5,975,216	5,689,620	285,596
	1907	63	33,576,347	31,322,130	21,357,139	9,964,991	68.2	2,254,217	12,219,208	9,513,767	2,705,441	2,264,343	441,098
	1902	49	13,553,639	13,553,089	7,632,175	5,920,914	56.3	550	5,921,464	2,722,579	3,198,885	857,488	2,341,397
NEW ENGLAND:													
Maine	1912	16	3,593,617	3,518,322	2,002,617	1,515,705	56.9	75,295	1,591,000	1,193,095	397,905	329,882	68,023
	1907	17	2,293,197	2,259,649	1,480,544	779,105	65.5	33,548	812,653	469,277	343,376	186,694	156,682
	1902	19	1,571,562	1,542,508	1,127,660	414,848	73.1	29,054	443,902	337,050	106,852	67,829	39,023
New Hampshire	1912	13	1,250,391	1,246,184	987,934	258,250	79.3	4,207	262,457	211,831	50,626	91,755	*41,129*
	1907	16	1,092,182	1,088,957	895,862	193,095	82.3	3,225	196,320	112,510	83,810	74,170	9,640
	1902	7	604,131	604,131	478,849	125,282	79.3	....	125,282	83,786	41,496	8,250	33,246
Vermont	1912	9	631,241	600,717	345,268	255,449	57.5	30,524	285,973	169,912	116,061	83,147	32,914
	1907	10	454,252	441,389	313,845	127,544	71.1	12,863	140,407	117,601	22,806	18,000	4,806
	1902	9	249,228	249,228	201,179	48,049	80.7	....	48,049	45,089	2,960	8,750	*5,790*
Massachusetts	1912	43	37,490,704	36,841,475	24,889,596	11,951,879	67.6	649,229	12,601,108	9,047,779	3,553,329	3,521,465	31,864
	1907	62	31,073,962	30,925,503	21,179,642	9,745,861	68.5	148,459	9,894,320	7,061,339	2,832,981	2,421,056	411,925
	1902	74	23,633,410	23,617,570	16,403,667	7,213,903	69.5	15,840	7,229,743	5,108,619	2,121,124	1,910,060	211,064
Rhode Island and Connecticut.	1912	10	14,457,064	14,308,385	9,090,782	5,217,603	63.5	148,679	5,366,282	3,439,952	1,926,330	1,831,765	94,565
	1907	13	11,838,033	11,704,568	7,601,929	4,102,639	64.9	133,465	4,236,104	3,693,440	542,664	57,656	485,008
	1902	28	7,320,035	7,248,349	4,666,085	2,582,264	64.4	71,686	2,653,950	1,480,086	1,173,864	991,062	182,802
MIDDLE ATLANTIC:													
New York	1912	101	123,523,376	118,672,650	66,401,113	52,271,537	56.0	4,850,726	57,122,263	43,168,721	13,953,542	12,229,777	1,723,765
	1907	101	91,685,673	89,856,329	50,928,855	38,927,474	56.7	1,829,344	40,756,818	35,354,087	5,402,731	5,565,664	*162,933*
	1902	96	60,881,780	59,315,606	33,677,724	25,637,882	56.8	1,566,174	27,204,056	19,552,955	7,651,101	3,133,655	4,517,446
New Jersey	1912	24	18,321,483	18,081,276	10,552,653	7,528,623	58.4	240,207	7,768,830	7,232,887	535,943	654,405	*118,462*
	1907	24	13,082,658	12,895,532	7,905,138	4,990,394	61.3	187,126	5,177,520	5,755,396	*577,876*	172,928	*750,804*
	1902	25	8,176,923	8,137,477	4,324,112	3,813,365	53.1	39,446	3,852,811	3,625,740	227,071	78,420	148,651
Pennsylvania	1912	121	56,194,047	54,922,898	31,702,938	23,219,960	57.7	1,271,149	24,491,109	24,885,197	*394,088*	1,264,883	*1,658,971*
	1907	122	45,706,986	44.654,130	26,003,748	18,650,382	58.2	1,052,856	19,703,238	19,344,023	359,215	977,228	*618,013*
	1902	98	30,357,727	30,319,211	15,624,813	14,694,398	51.5	38,516	14,732,914	12,868,286	1,864,628	621,811	1,242,817
EAST NORTH CENTRAL:													
Ohio	1912	75	40,706,038	39,437,574	24,543,633	14,893,941	62.2	1,268,464	16,162,405	11,635,394	4,527,011	3,146,899	1,380,112
	1907	73	31,274,901	30,392,675	18,479,609	11,913,066	60.8	882,226	12,795,292	9,215,583	3,579,709	2,315,688	1,264,021
	1902	62	16,599,851	16,587,693	9,132,480	7,455,213	55.1	12,158	7,467,371	4,137,866	3,329,505	1,644,598	1,684,907
Indiana	1912	34	16,142,075	15,718,651	9,132,539	6,586,112	58.1	423,424	7,009,536	5,727,969	1,281,567	924,730	356,837
	1907	33	11,496,768	11,224,545	6,308,152	4,916,393	56.2	272,223	5,188,616	4,477,535	711,081	148,498	562,583
	1902	26	3,813,076	3,813,076	2,219,791	1,593,285	58.2	....	1,593,285	1,201,297	391,988	33,974	358,014
Illinois	1912	67	55,899,544	54,588,533	29,822,058	24,766,475	54.6	1,311,011	26,077,486	20,903,293	5,174,193	5,409,635	*235,442*
	1907	70	40,951,652	40,448,084	25,597,996	14,850,088	63.3	503,568	15,353,656	10,668,510	4,685,146	2,337,129	2,348,017
	1902	48	25,029,257	24,164,965	14,103,211	10,061,754	58.4	864,292	10,926,046	8,453,191	2,472,855	2,310,710	162,145
Michigan	1912	22	17,864,692	17,683,808	11,142,975	6,540,833	63.0	180,884	6,721,717	4,642,698	2,079,019	1,025,580	1,053,439
	1907	24	11,031,974	10,948,588	6,549,919	4,398,669	59.8	83,386	4,482,055	2,867,083	1,614,972	687,530	927,442
	1902	24	6,521,173	6,494,691	3,655,328	2,839,363	56.3	26,482	2,865,845	1,788,797	1,077,048	612,000	465,048
Wisconsin	1912	24	8,648,124	7,846,593	4,105,913	3,740,680	52.3	801,531	4,542,211	2,984,632	1,557,579	1,449,980	107,599
	1907	20	6,662,817	6,135,064	3,235,068	2,899,996	52.7	527,753	3,427,749	2,180,929	1,246,820	1,068,187	178,633
	1902	17	3,923,884	3,902,059	1,995,024	1,907,035	51.1	21,825	1,928,860	1,081,160	847,700	300,563	547,137

[1] Italic figures indicate deficits.
[2] Exclusive of 6 companies which failed to furnish this information.
[3] Exclusive of 18 companies which failed to furnish this information.

TABLE 158.—CONDENSED INCOME ACCOUNT OF OPERATING COMPANIES, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902—Continued.

DIVISION AND STATE.	Census.	Number of companies.	Gross income.	OPERATING ACCOUNTS.				Miscellaneous income.	Gross income less operating expenses.	Deductions from income (taxes and fixed charges).	Net income.[1]	Dividends.	Surplus.[1]
				Revenues.	Expenses.	Net revenues.	Per cent ratio; expenses of revenues.						
WEST NORTH CENTRAL:													
Minnesota	1912	9	$9,685,158	$9,675,508	$5,882,755	$3,792,753	60.8	$9,650	$3,802,403	$1,890,203	$1,912,200	$1,668,500	$243,700
	1907	5	7,056,508	7,048,370	3,524,346	3,524,024	50.0	8,138	3,532,162	2,128,156	1,404,006	1,215,000	189,006
	1902	5	3,727,648	3,727,648	1,719,687	2,007,961	46.1		2,007,961	1,027,121	980,840	870,400	110,440
Iowa	1912	24	7,452,454	7,372,945	4,520,635	2,852,310	61.3	79,509	2,931,819	1,478,449	1,453,370	703,497	749,873
	1907	24	4,391,140	4,295,930	2,826,959	1,468,971	65.8	95,210	1,564,181	894,434	669,747	218,900	450,847
	1902	22	2,403,834	2,384,421	1,460,993	923,428	61.3	19,413	942,841	429,373	513,468	117,660	395,808
Missouri	1912	19	21,240,533	21,115,228	13,070,500	8,044,728	61.9	125,305	8,170,033	5,903,974	2,266,059	281,600	1,984,459
	1907	14	18,082,732	18,000,248	9,680,226	8,320,022	53.8	82,484	8,402,506	6,150,063	2,252,443	1,019,000	1,233,443
	1902	16	10,734,692	10,691,220	6,071,971	4,619,249	56.8	43,472	4,662,721	4,635,401	27,320	313,337	*286,017*
North Dakota and South Dakota.[2]	1912	5	238,587	238,587	162,123	76,464	68.0		76,464	40,865	35,599	28,170	7,429
	1907	5	112,129	112,079	72,412	39,667	64.6	50	39,717	19,993	19,724		19,724
Nebraska	1912	7	3,618,337	3,577,746	2,021,647	1,556,099	56.5	40,591	1,596,690	1,037,505	559,185	550,120	9,065
	1907	8	2,744,104	2,737,756	1,325,038	1,412,718	48.4	6,348	1,419,066	895,573	523,493	458,032	65,461
	1902	4	1,148,994	1,148,994	655,729	493,265	57.1		493,265	150,297	342,968	230,800	112,168
Kansas	1912	21	2,944,154	2,901,310	1,705,737	1,195,573	58.8	42,844	1,238,417	874,495	363,922	40,299	323,623
	1907	17	1,478,846	1,439,813	775,207	664,606	53.8	39,033	703,639	305,888	397,751	80,460	317,291
	1902	11	370,481	370,481	257,248	113,233	69.4		113,233	64,451	48,782	4,000	44,782
SOUTH ATLANTIC:													
Delaware, Maryland, and District of Columbia.	1912	25	17,318,667	16,619,698	8,718,499	7,901,199	52.5	698,969	8,600,168	6,031,007	2,569,161	2,025,750	543,411
	1907	23	12,890,776	12,373,382	6,460,116	5,913,266	52.2	517,394	6,430,660	3,911,923	2,518,737	1,202,000	1,316,737
	1902	21	8,393,872	8,393,725	4,231,128	4,162,597	50.4	147	4,162,744	3,314,632	848,112	616,158	231,954
Virginia	1912	18	7,247,056	6,847,216	3,875,733	2,971,483	56.6	399,840	3,371,323	2,434,012	937,311	838,688	98,623
	1907	22	5,401,415	5,152,173	3,261,570	1,890,603	63.3	249,242	2,139,845	1,287,931	851,914	68,750	783,164
	1902	16	1,667,022	1,553,478	1,009,356	544,122	65.0	113,544	657,666	547,730	109,936	33,395	76,541
West Virginia	1912	21	3,708,197	3,615,257	1,910,770	1,704,487	52.9	92,940	1,797,427	994,778	802,649	493,573	309,076
	1907	15	2,588,725	2,562,800	1,540,395	1,022,405	60.1	25,925	1,048,330	743,200	305,130	26,400	278,730
	1902	8	1,102,171	1,102,171	652,862	449,309	59.2		449,309	265,842	183,467	22,000	161,467
North Carolina	1912	13	2,348,715	2,127,884	1,416,802	711,082	66.6	220,831	931,913	534,904	397,009	185,501	211,508
	1907	11	1,295,477	1,186,469	743,357	443,112	62.7	109,008	552,120	353,806	198,314		198,314
	1902	7	442,467	437,259	322,344	114,915	73.7	5,208	120,123	98,993	21,130		21,130
South Carolina	1912	6	1,355,270	1,345,450	914,391	431,059	68.0	9,820	440,879	300,118	140,761		140,761
	1907	7	1,336,457	1,273,617	762,853	510,764	59.9	62,840	573,604	390,713	182,891		182,891
	1902	7	653,736	597,577	398,662	198,915	66.7	56,159	255,074	203,196	51,878	720	51,158
Georgia	1912	14	7,421,747	6,934,010	3,600,445	3,333,565	51.9	487,737	3,821,302	2,557,659	1,263,643	611,183	652,460
	1907	12	4,720,595	4,616,337	2,555,713	2,060,624	55.4	104,258	2,164,882	1,124,989	1,039,893	643,787	396,106
	1902	10	2,375,224	2,375,224	1,232,320	1,142,904	51.9		1,142,904	755,207	387,697	33,952	353,745
Florida	1912	10	1,969,815	1,968,990	1,155,091	813,899	58.7	325	814,224	424,717	389,507	294,769	94,738
	1907	10	1,371,541	1,367,210	956,860	410,350	70.0	4,331	414,681	186,222	228,459	198,400	30,059
	1902	6	529,743	529,743	339,375	190,368	64.1		190,368	74,779	115,589	40,720	74,869
EAST SOUTH CENTRAL:													
Kentucky	1912	10	6,155,248	5,919,344	3,556,537	2,362,807	60.1	235,904	2,598,711	1,315,752	1,282,959	1,237,935	45,024
	1907	13	4,791,933	4,776,098	2,825,497	1,950,601	59.2	15,835	1,966,436	1,109,233	857,203	625,938	231,265
	1902	12	2,933,800	2,932,901	1,560,270	1,372,631	53.2	899	1,373,530	777,433	596,097	371,000	225,097
Tennessee	1912	12	6,151,953	6,124,678	3,257,823	2,866,855	53.2	27,275	2,894,130	1,919,301	974,829	670,554	304,275
	1907	9	4,480,991	4,443,891	2,434,252	2,009,639	54.8	37,100	2,046,739	1,418,575	628,164	284,676	343,488
	1902	8	1,866,835	1,866,835	1,079,237	787,598	57.8		787,598	595,356	192,242		192,242
Alabama	1912	11	4,344,668	4,140,937	2,401,152	1,739,785	58.0	203,731	1,943,516	1,195,680	747,836	551,750	196,086
	1907	10	3,467,476	3,365,979	2,276,100	1,089,879	67.6	101,497	1,191,376	988,048	203,328	250,868	*47,540*
	1902	9	1,497,351	1,497,351	878,291	619,060	58.7		619,060	384,762	234,298	81,000	153,298
Mississippi	1912	12	10,390	899,524	651,866	247,658	72.5	10,866	258,524	296,,833	*38,309*		*38,309*
	1907	8	906,289	817,769	534,542	283,227	65.4	88,520	371,747	247,833	123,914		123,914
	1902	5	258,654	258,654	192,056	66,598	74.3		66,598	38,684	27,914		27,914
WEST SOUTH CENTRAL:													
Arkansas	1912	10	1,891,949	1,831,185	1,001,342	829,843	54.7	60,764	890,607	474,638	415,969	289,195	126,774
	1907	8	1,275,396	1,215,954	683,262	532,692	56.2	59,442	592,134	263,537	328,597	105,228	223,369
	1902	7	371,560	371,560	216,433	155,127	58.2		155,127	68,071	87,056		87,056
Louisiana	1912	13	6,998,131	5,312,372	3,232,460	2,079,912	60.8	1,685,759	3,765,671	2,295,075	1,470,596	1,339,745	130,851
	1907	11	5,994,975	4,508,104	2,682,481	1,825,623	59.5	1,486,871	3,312,494	1,890,680	1,421,814	994,698	427,116
	1902	8	2,910,244	2,910,244	1,758,989	1,151,255	60.4		1,151,255	690,380	460,875	362,198	98,677
Oklahoma[3]	1912	17	1,449,278	1,445,842	970,447	475,395	67.1	3,436	478,831	498,584	*19,758*	25,215	*44,968*
	1907	8	577,957	564,196	357,917	206,279	63.4	13,761	220,040	109,230	110,810	150,000	*39,190*
Texas	1912	39	8,514,403	8,441,111	5,186,588	3,254,523	61.4	73,292	3,327,815	1,871,243	1,456,572	760,265	696,307
	1907	23	4,857,997	4,856,640	3,093,220	1,763,420	63.7	1,357	1,764,777	932,282	832,495	275,170	557,325
	1902	17	1,547,846	1,547,846	993,600	554,246	64.2		554,246	199,483	354,763	22,600	332,163

[1] Italic figures indicate deficits.
[2] No company reported in 1902 for North Dakota, and the 1 company in South Dakota in 1902 failed to furnish this information.
[3] No company reported in 1902.

TABLE 158.—CONDENSED INCOME ACCOUNT OF OPERATING COMPANIES, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902—Continued.

DIVISION AND STATE.	Census.	Number of companies.	Gross income.	OPERATING ACCOUNTS.				Miscellaneous income.	Gross income less operating expenses.	Deductions from income (taxes and fixed charges).	Net income.[1]	Dividends.	Surplus.[1]
				Revenues.	Expenses.	Net revenues.	Per cent ratio; expenses of revenues.						
MOUNTAIN:													
Montana	1912	6	$1,065,597	$1,055,283	$770,586	$284,697	73.0	$10,314	$295,011	$224,729	$70,282	$30,000	$40,282
	1907	5	902,621	760,201	551,933	208,268	72.6	142,420	350,688	120,851	229,837	35,530	194,307
	1902	5	492,023	492,023	365,073	126,950	74.2	....	126,950	74,633	52,317	....	52,317
Colorado	1912	16	6,630,480	5,829,146	3,264,753	2,564,393	56.0	801,334	3,365,727	2,106,967	1,258,760	1,339,285	*80,525*
	1907	11	4,483,254	4,130,962	2,099,421	2,031,541	50.8	352,292	2,383,833	1,273,024	1,110,809	307,124	803,685
	1902	7	2,227,766	2,227,286	1,300,606	926,680	58.4	480	927,160	536,005	391,155	180,000	211,155
All other Mountain states	1912	18	4,254,659	4,218,190	2,390,886	1,827,304	56.7	36,469	1,863,773	1,397,370	466,403	31,000	435,403
Idaho, Wyoming, Nevada, and Utah	1912	12	3,894,371	3,873,085	2,097,899	1,775,186	54.2	21,286	1,796,472	1,302,819	493,653	....	493,653
New Mexico and Arizona	1912	6	360,288	345,105	292,987	52,118	84.9	15,183	67,301	94,551	*27,250*	31,000	*58,250*
All other Mountain states	1907	12	2,313,518	2,284,737	1,448,129	836,608	63.4	28,781	865,389	517,452	347,937	....	347,937
	1902	6	612,988	587,705	374,269	213,436	63.7	25,283	238,719	176,723	61,996	3,000	58,996
PACIFIC:													
Washington	1912	19	13,590,933	12,706,499	7,116,198	5,590,301	56.0	884,434	6,474,735	4,033,973	2,440,762	2,232,514	208,248
	1907	14	8,402,560	7,898,743	5,140,501	2,758,242	65.1	503,817	3,262,059	1,788,314	1,473,745	556,543	917,202
	1902	8	2,542,906	2,542,906	1,576,018	966,888	62.0	....	966,888	463,101	503,787	150,028	353,759
Oregon	1912	6	7,856,471	7,700,119	3,736,259	3,963,860	48.5	156,352	4,120,212	3,050,248	1,069,964	2,334,260	*1,264,296*
	1907	8	3,627,990	2,731,674	1,638,271	1,093,403	60.0	896,316	1,989,719	992,748	996,971	535,000	461,971
	1902	6	1,042,895	1,042,895	653,912	388,983	62.7	....	388,983	146,519	242,464	54,048	188,416
California	1912	35	34,845,771	34,080,579	21,684,312	12,396,267	63.6	765,192	13,161,459	10,696,969	2,464,490	1,122,846	1,341,644
	1907	41	21,545,797	20,691,713	14,578,367	6,113,346	70.5	854,084	6,967,430	6,732,705	234,725	1,172,800	*938,075*
	1902	35	9,967,838	9,967,288	5,402,245	4,565,043	54.2	550	4,565,593	2,112,959	2,452,634	653,412	1,799,222

[1] Italic figures indicate deficits.

TABLE 159.—INCOME ACCOUNT OF NONOPERATING OR LESSOR COMPANIES, BY STATES: 1912, 1907, AND 1902.

STATE.	Census.	Number of companies.	INCOME.			DEDUCTIONS FROM INCOME.			Net income.[1]	Dividends.	Surplus.[1]
			Gross income.	Rentals from operating companies.	Miscellaneous.	Total.	Interest.	Taxes and miscellaneous.			
United States	1912	285	$35,605,367	$35,144,521	$460,846	$16,090,372	$15,234,132	$856,240	$19,514,995	$19,342,101	$172,894
	1907	291	47,913,249	47,500,933	412,316	19,465,984	18,030,522	1,435,462	28,447,265	28,030,542	416,723
	1902	[2] 158	26,138,899	26,116,884	22,015	8,779,294	8,376,559	402,735	17,359,605	17,157,061	202,544
California	1912	7	252,995	252,858	137	253,674	236,301	17,373	*679*	....	*679*
Illinois	1912	5	260,202	252,311	7,891	135,682	97,929	37,753	124,520	187,273	*62,753*
	1907	16	2,628,488	2,628,488	....	2,082,798	1,887,758	195,040	545,690	533,500	12,190
	1902	8	3,758,762	3,758,762	....	1,323,507	1,323,507	....	2,435,255	2,435,255	....
Indiana	1912	11	1,726,807	1,725,231	1,576	1,215,716	1,063,781	151,935	511,091	504.622	6,469
	1907	10	1,945,781	1,945,781	....	1,382,797	1,374,870	7,927	562,984	558,560	4,424
Massachusetts	1912	17	1,050,882	1,048,894	1,988	900,047	845,854	54,193	150,835	148,550	2,285
	1907	19	2,128,500	2,119,919	8,581	758,271	741,811	16,460	1,370,229	1,368,633	1,596
	1902	18	1,986,774	1,986,774	....	705,967	695,678	10,289	1,280,807	1,272,395	8,412
New Jersey	1912	19	3,109,034	3,073,300	35,734	1,862,343	1,836,258	26,085	1,246,691	1,259,457	*12,766*
	1907	17	2,166,850	2,166,765	85	1,374,619	1,364,360	10,259	792,231	780,970	11,261
	1902	4	1,586,217	1,586,217	....	1,165,747	1,160,560	5,187	420,470	369,220	51,250
New York	1912	33	9,540,387	9,457,292	83,095	2,889,616	2,813,773	75,843	6,650,771	6,495,213	155,558
	1907	46	18,882,040	18,870,857	11,183	7,206,569	7,101,331	105,238	11,675,471	11,689,769	*14,298*
	1902	23	5,703,608	5,697,399	6,209	1,937,801	1,908,060	29,741	3,765,807	3,747,209	18,598
Ohio	1912	13	3,376,083	3,365,315	10,768	1,508,286	1,468,049	40,237	1,867,797	1,865,697	2,100
	1907	17	3,178,599	3,178,599	....	1,340,120	1,317,587	22,533	1,838,479	1,838,479	....
	1902	4	1,059,814	1,059,814	....	55,425	55,425	....	1,004,389	988,956	15,433
Pennsylvania	1912	138	9,650,103	9,620,676	29,427	3,777,583	3,611,740	165,843	5,872,520	5,804,039	68,481
	1907	140	13,937,422	13,631,311	306,111	3,698,671	2,709,769	988,902	10,238,751	9,914,220	324,531
	1902	86	9,608,918	9,593,112	15,806	1,821,203	1,497,969	323,234	7,787,715	7,529,069	258,646
All other states[3]	1912	42	6,638,874	6,348,644	290,230	3,547,425	3,260,447	286,978	3,091,449	3,077,250	14,199
	1907	26	3,045,569	2,959,218	86,356	1,622,139	1,533,036	89,103	1,423,430	1,346,411	77,019
	1902	15	2,434,806	2,434,806	....	1,769,644	1,735,360	34,284	665,162	814,957	*149,795*

[1] Italic figures indicate deficits.

[2] Exclusive of 12 companies which failed to furnish this information.

[3] Includes states as follows: 1912—Alabama, 1; Colorado, 1; Connecticut, 4; Delaware, 4; Georgia, 1; Idaho, 1; Iowa, 2; Louisiana, 2; Maine, 1; Maryland, 3; Michigan, 1; Nebraska, 3; North Carolina, 2; Oklahoma, 1; Rhode Island, 6; South Carolina, 1; Texas, 1; Virginia, 2; Washington, 1; West Virginia, 3; Wisconsin, 1. 1907—California, 1; Connecticut, 3; Delaware, 3; Iowa, 2; Louisiana, 1; Maryland, 2; Nebraska, 2; New Hampshire, 2; North Carolina, 1; Rhode Island, 3; Utah, 1; Virginia, 1; Washington, 1; West Virginia, 3. 1902—Colorado, 1; Connecticut, 4; Maine, 1; Maryland, 2; Missouri, 1; New Hampshire, 6.

TABLE 160.—CONDENSED INCOME ACCOUNT OF OPERATING AND

	STATE.	Census.	NUMBER OF COMPANIES.			Gross income.	Rentals from operating companies.	OPERATING ACCOUNTS.		
			Total.	Operating.	Lessor.			Revenues.	Expenses.	Net revenues.
1	United States	1912	1,260	975	285	$621,535,884	$35,144,521	$567,511,704	$332,896,356	$234,615,348
2		1907	[2] 1,230	939	291	477,657,503	47,500,933	418,187,858	251,309,252	166,878,606
3		1902	[3] 957	799	158	276,643,526	26,116,884	247,553,999	142,312,597	105,241,402
4	States having operating and lessor companies.	1912	1,096	811	285	549,894,475	35,144,521	497,223,521	291,731,077	205,492,444
5		1907	971	680	291	388,634,051	47,500,933	332,350,677	202,432,908	129,917,769
6		1902	641	483	158	215,210,400	26,116,884	186,390,383	107,331,024	79,059,359
7	California [4]	1912	42	35	7	35,098,766	252,858	34,080,579	21,684,312	12,396,267
8	Illinois	1912	72	67	5	56,159,746	252,311	54,588,533	29,822,058	24,766,475
9		1907	86	70	16	43,580,140	2,628,488	40,448,084	25,597,996	14,850,088
10		1902	56	48	8	28,788,019	3,758,762	24,164,965	14,103,211	10,061,754
11	Indiana [6]	1912	45	34	11	17,868,882	1,725,231	15,718,651	9,132,539	6,586,112
12		1907	43	33	10	13,442,549	1,945,781	11,224,545	6,308,152	4,916,393
13	Massachusetts	1912	60	43	17	38,541,586	1,048,894	36,841,475	24,889,596	11,951,879
14		1907	81	62	19	33,202,462	2,119,919	30,925,503	21,179,642	9,745,861
15		1902	92	74	18	25,620,184	1,986,774	23,617,570	16,403,667	7,213,903
16	New Jersey	1912	43	24	19	21,430,517	3,073,300	18,081,276	10,552,653	7,528,623
17		1907	41	24	17	15,249,508	2,166,765	12,895,532	7,905,138	4,990,394
18		1902	29	25	4	9,763,140	1,586,217	8,137,477	4,324,112	3,813,365
19	New York	1912	134	101	33	133,063,763	9,457,292	118,672,650	66,401,113	52,271,537
20		1907	147	101	46	110,567,713	18,870,857	89,856,329	50,928,855	38,927,474
21		1902	119	96	23	66,585,388	5,697,399	59,315,606	33,677,724	25,637,882
22	Ohio	1912	88	75	13	44,082,121	3,365,315	39,437,574	24,543,633	14,893,941
23		1907	90	73	17	34,453,500	3,178,599	30,392,675	18,479,609	11,913,066
24		1902	66	62	4	17,659,665	1,059,814	16,587,693	9,132,480	7,455,213
25	Pennsylvania	1912	259	121	138	65,844,150	9,620,676	54,922,898	31,702,938	23,219,960
26		1907	262	122	140	59,644,408	13,631,311	44,654,130	26,003,748	18,650,382
27		1902	184	98	86	39,966,645	9,593,112	30,319,211	15,624,813	14,694,398
28	All other	1912	353	311	42	137,804,944	6,348,644	124,879,885	73,002,235	51,877,650
29		1907	221	195	26	78,493,771	2,959,213	71,953,879	46,029,768	25,924,111
30		1902	95	80	15	26,827,359	2,434,806	24,247,861	14,065,017	10,182,844
31	States having operating companies only	1912	164	164	....	71,641,409	....	70,288,183	41,165,279	29,122,904
32		1907	259	259	....	89,023,452	....	85,837,181	48,876,344	36,960,837
33		1902	316	316	....	61,433,126	....	61,163,616	34,981,573	26,182,043

[1] Italic figures indicate deficits.
[2] Exclusive of 6 companies which failed to furnish this information.
[3] Exclusive of 30 companies which failed to furnish this information.

LESSOR COMPANIES COMBINED, BY STATES: 1912, 1907, AND 1902.

Miscellaneous income.	Gross income less operating expenses.	DEDUCTIONS FROM INCOME (TAXES AND FIXED CHARGES).				Net income.	Dividends.	Surplus.[1]	
		Total.	Interest.	Rent of leased lines and terminals.	Miscellaneous, including taxes.				
$18,879,659	$288,639,528	$207,213,780	$113,259,470	$44,784,521	$49,169,789	$81,425,748	$70,992,218	$10,433,530	1
11,968,712	226,348,251	157,560,700	81,771,266	48,022,596	27,766,838	68,787,551	54,485,274	14,302,277	2
2,972,643	134,330,929	86,374,347	46,462,470	25,518,225	14,393,652	47,956,582	33,039,171	14,917,411	3
17,526,433	258,163,398	187,653,673	99,154,459	44,756,910	43,742,304	70,509,725	62,506,034	8,003,691	4
8,782,441	186,201,143	133,001,619	63,387,517	48,007,850	21,606,252	53,199,524	45,653,682	7,545,842	5
2,703,133	107,879,376	71,802,227	34,828,503	25,493,441	11,480,283	36,077,149	27,660,793	8,416,356	6
765,329	13,414,454	10,950,643	7,716,862	255,416	2,978,365	2,463,811	1,122,846	1,340,965	7
1,318,902	26,337,688	21,038,975	12,280,523	494,136	8,264,316	5,298,713	5,596,908	*298,195*	8
503,568	17,982,144	12,751,308	7,795,393	2,648,012	2,307,903	5,230,836	2,870,629	2,360,207	9
864,292	14,684,808	9,776,698	4,361,337	3,875,007	1,540,354	4,908,110	4,745,965	162,145	10
425,000	8,736,343	6,943,685	4,281,053	1,744,017	918,615	1,792,658	1,429,352	363,306	11
272,223	7,134,397	5,860,332	3,258,142	1,966,943	635,247	1,274,065	707,058	567,007	12
651,217	13,651,990	9,947,826	4,115,136	2,542,459	3,290,231	3,704,164	3,670,015	34,149	13
157,040	12,022,820	7,819,610	3,352,738	2,145,639	2,321,233	4,203,210	3,789,689	413,521	14
15,840	9,216,517	5,814,586	2,219,926	1,967,540	1,627,120	3,401,931	3,182,455	219,476	15
275,941	10,877,864	9,095,230	4,569,033	3,229,045	1,297,152	1,782,634	1,913,862	*131,228*	16
187,211	7,344,370	7,130,015	4,205,064	2,272,148	652,803	214,355	953,898	*739,543*	17
39,446	5,439,028	4,791,487	2,733,971	1,586,217	471,299	647,541	447,640	199,901	18
4,933,821	66,662,650	46,058,337	24,352,988	12,684,642	9,020,707	20,604,313	18,724,990	1,879,323	19
1,840,527	59,638,858	42,560,656	16,832,136	19,279,392	6,449,128	17,078,202	17,255,433	*177,231*	20
1,572,383	32,907,664	21,490,756	12,241,187	5,719,589	3,529,980	11,416,908	6,880,864	4,536,044	21
1,279,232	19,538,488	13,143,680	6,897,178	3,390,165	2,856,337	6,394,808	5,012,596	1,382,212	22
882,226	15,973,891	10,555,703	5,930,019	3,155,380	1,470,304	5,418,188	4,154,167	1,264,021	23
12,158	8,527,185	4,193,291	2,513,009	1,066,636	613,646	4,333,894	2,633,554	1,700,340	24
1,300,576	34,141,212	28,662,780	10,019,675	13,995,098	4,648,007	5,478,432	7,068,922	*1,590,490*	25
1,358,967	33,640,660	23,042,694	7,029,518	13,554,786	2,458,390	10,597,966	10,891,448	*293,482*	26
54,322	24,341,832	14,689,489	3,554,135	8,902,431	2,232,923	9,652,343	8,150,880	1,501,463	27
6,576,415	64,802,709	41,812,517	24,922,011	6,421,932	10,468,574	22,990,192	17,966,543	5,023,649	28
3,580,679	32,464,003	23,281,301	14,984,507	2,985,550	5,311,244	9,182,702	5,031,360	4,151,342	29
144,692	12,762,342	11,045,920	7,204,938	2,376,021	1,464,961	1,716,422	1,619,435	96,987	30
1,353,226	30,476,130	19,560,107	14,105,011	27,611	5,427,485	10,916,023	8,486,184	2,429,839	31
3,186,271	40,147,108	24,559,081	18,383,749	14,746	6,160,586	15,588,027	8,831,592	6,756,435	32
269,510	26,451,553	14,572,120	11,633,967	24,784	2,913,369	11,879,433	5,378,378	6,501,055	33

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[4] Included in "All other" in 1907 and with "States having operating companies only" in 1902.
[5] Included with "States having operating companies only" in 1902.

TABLE 161.—OPERATING REVENUES, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902.

DIVISION AND STATE.	Census.	Number of companies.	Total operating revenue.	Passenger.	Parlor, chair, and special car.[1]	Freight.	Mail.	Baggage, express, and milk.[2]	Other transportation revenue.[3]	Sale of electric current.	Other nontransportation revenue.[4]
UNITED STATES	1912	975	$567,511,704	$502,651,637	$1,036,520	$10,165,616	$723,640	$3,687,947	$1,919,413	$36,500,030	$10,826,901
	1907	[5] 939	418,187,858	382,132,494	705,261	5,231,215	646,575	1,560,802	....	20,093,302	7,818,209
	1902	[6] 799	247,553,999	233,821,548	303,608	1,038,097	432,080	401,672	....	7,703,574	3,853,420
GEOGRAPHIC DIVISIONS:											
New England	1912	91	56,515,083	52,520,531	194,012	826,646	105,118	404,179	79,656	1,384,764	1,000,177
	1907	118	46,420,066	43,187,257	149,634	286,385	103,368	261,332	....	1,564,744	867,346
	1902	137	33,261,786	31,617,422	57,831	178,276	69,460	32,633	....	736,976	569,188
Middle Atlantic	1912	246	191,676,824	180,633,603	252,475	1,407,074	168,163	707,422	473,583	3,381,090	4,653,414
	1907	247	147,405,991	140,570,256	172,692	781,690	185,866	519,009	....	2,017,330	3,159,148
	1902	219	97,772,294	94,874,758	99,410	238,251	131,276	92,786	....	625,570	1,710,243
East North Central	1912	222	135,275,159	118,127,553	324,716	3,492,543	172,862	1,759,893	729,545	8,330,313	2,337,734
	1907	220	99,148,956	89,261,625	179,842	2,131,237	141,888	544,870	....	4,604,756	2,284,738
	1902	177	54,962,484	51,267,333	88,725	301,692	91,652	239,526	....	2,152,612	820,944
West North Central	1912	85	44,881,324	40,853,962	40,834	727,275	126,797	131,229	114,723	2,233,356	653,148
	1907	73	33,634,196	31,578,834	30,672	229,821	91,563	34,485	....	1,312,722	356,099
	1902	58	18,322,764	17,483,675	11,988	24,927	53,969	13,524	....	576,526	158,155
South Atlantic	1912	107	39,458,505	30,921,390	60,864	519,795	60,310	189,703	59,928	7,089,358	557,157
	1907	100	28,531,988	22,985,107	25,081	210,613	59,924	76,333	....	4,756,566	418,364
	1902	75	14,989,177	12,794,719	18,354	74,735	46,999	13,187	....	1,754,372	286,811
East South Central	1912	45	17,084,483	13,868,509	11,240	171,760	15,749	102,851	29,019	2,766,420	118,935
	1907	40	13,403,737	11,205,655	19,599	154,110	13,535	1,115	....	1,841,790	167,933
	1902	34	6,555,741	5,830,030	3,799	38,233	8,419	5,524	....	642,134	27,602
West South Central	1912	79	17,030,510	14,790,406	28,043	43,507	5,816	24,735	37,536	1,860,737	239,730
	1907	50	11,144,894	9,883,647	13,932	14,191	5,586	8,149	....	1,102,418	116,971
	1902	32	4,829,650	4,659,255	6,821	3,026	2,237	719	....	104,242	53,350
Mountain	1912	40	11,102,619	8,060,857	26,634	126,632	4,951	50,883	21,561	2,628,273	182,828
	1907	28	7,175,900	5,626,355	22,770	128,232	2,722	1,503	....	1,343,987	50,331
	1902	18	3,307,014	3,047,246	9,303	50,544	3,165	34	....	156,604	40,118
Pacific	1912	60	54,487,197	42,874,826	97,702	2,850,384	63,874	317,052	373,862	6,825,719	1,083,778
	1907	63	31,322,130	27,833,758	91,039	1,294,936	42,123	114,006	....	1,548,989	397,279
	1902	49	13,553,089	12,247,110	7,377	128,413	24,903	3,739	....	954,538	187,009
NEW ENGLAND:											
Maine	1912	16	3,518,322	2,458,114	5,697	159,704	11,494	16,040	20,821	789,166	57,286
	1907	17	2,259,649	1,872,405	4,217	95,075	9,260	13,135	....	228,537	37,020
	1902	19	1,542,508	1,311,198	251	80,380	6,179	9,409	....	102,318	32,773
New Hampshire	1912	13	1,246,184	1,201,565	6,011	18,457	2,578	2,022	1,293	....	14,258
	1907	16	1,088,957	1,022,365	3,575	13,726	4,350	550	....	21,293	23,098
	1902	7	604,131	579,546	....	1,182	4,050	120	....	10,625	8,608
Vermont	1912	9	600,717	423,348	973	50,590	2,717	6,590	445	100,744	15,310
	1907	10	441,389	380,659	826	38,622	2,610	3,850	....	9,779	5,043
	1902	9	249,228	216,013	....	23,351	2,201	1,768	....	....	5,895
Massachusetts	1912	43	36,841,475	35,145,740	130,204	91,114	73,328	267,425	36,975	396,124	700,565
	1907	62	30,925,503	29,524,676	103,489	72,640	73,743	50,666	....	471,704	628,585
	1902	74	23,617,570	22,807,316	43,182	12,876	48,454	4,140	....	250,109	451,493
Rhode Island and Connecticut	1912	10	14,308,385	13,291,764	51,127	506,781	15,001	112,102	20,122	98,730	212,758
	1907	13	11,704,568	10,387,152	37,527	66,322	13,405	193,131	....	833,431	173,600
	1902	28	7,248,349	6,703,349	14,398	60,487	8,576	17,196	....	373,924	70,419
MIDDLE ATLANTIC:											
New York	1912	101	118,672,650	110,699,835	99,161	866,584	73,482	372,851	189,195	2,555,803	3,815,739
	1907	101	89,856,329	84,605,880	77,453	612,865	93,186	438,994	....	1,369,339	2,658,612
	1902	96	59,315,606	57,347,930	53,418	197,324	65,077	64,213	....	471,509	1,116,135
New Jersey	1912	24	18,081,276	17,615,561	49,715	40,501	13,169	13,387	15,208	116,829	216,906
	1907	24	12,895,532	12,682,531	40,108	20,105	7,252	198	....	83,494	61,844
	1902	25	8,137,477	7,989,544	21,585	5,364	4,822	96	....	15,459	100,607
Pennsylvania	1912	121	54,922,898	52,318,207	103,599	499,989	81,512	321,184	269,180	708,458	620,769
	1907	122	44,654,130	43,281,845	55,131	148,720	85,428	79,817	....	564,497	438,692
	1902	98	30,319,211	29,537,284	24,407	35,563	61,377	28,477	....	138,602	493,501
EAST NORTH CENTRAL:											
Ohio	1912	75	39,437,574	32,672,145	100,841	1,237,699	72,415	753,955	283,467	3,766,405	550,647
	1907	73	30,392,675	27,007,611	64,887	693,638	48,141	334,312	....	1,607,599	636,487
	1902	62	16,587,693	15,293,916	37,450	211,842	35,171	57,679	....	602,619	349,016
Indiana	1912	34	15,718,651	12,795,929	31,303	734,222	5,348	407,609	77,850	1,144,774	521,616
	1907	33	11,224,545	9,815,612	19,536	463,122	6,951	73,254	....	383,177	462,893
	1902	26	3,813,076	3,532,579	6,858	18,781	1,977	17,893	....	144,323	90,665
Illinois	1912	67	54,588,533	49,815,164	102,530	721,963	67,602	289,834	300,496	2,343,709	947,235
	1907	70	40,448,084	37,453,153	33,685	450,315	66,965	120,583	....	1,301,130	1,022,253
	1902	48	24,164,965	23,270,828	12,615	23,165	42,596	10,148	....	519,958	285,655
Michigan	1912	22	17,683,808	15,876,873	58,883	773,326	23,428	228,036	56,446	461,731	205,085
	1907	24	10,948,588	9,915,719	45,848	519,932	18,483	10,114	....	340,855	97,637
	1902	24	6,494,691	6,014,842	20,313	47,904	11,143	153,224	....	195,428	51,837
Wisconsin	1912	24	7,846,593	6,967,442	31,159	25,333	4,069	80,459	11,286	613,694	113,151
	1907	20	6,135,064	5,069,530	15,886	4,230	1,348	6,607	....	971,995	65,468
	1902	17	3,902,059	3,155,168	11,489	....	765	582	....	690,284	43,771

[1] Reported as "chartered cars" in 1907 and 1902.
[2] Reported as "express" in 1907 and 1902.
[3] Included with revenues from miscellaneous sources in 1907 and 1902.
[4] Reported as revenues from "miscellaneous sources" in 1907 and 1902.
[5] Exclusive of 6 companies which failed to furnish this information.
[6] Exclusive of 18 companies which failed to furnish this information.

Table 161.—OPERATING REVENUES, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902—Continued.

DIVISION AND STATE.	Census.	Number of companies.	Total operating revenue.	Passenger.	Parlor, chair, and special car.[1]	Freight.	Mail.	Baggage, express, and milk.[2]	Other transportation revenue.[3]	Sale of electric current.	Other nontransportation revenue.[4]
WEST NORTH CENTRAL:											
Minnesota	1912	9	$9,675,508	$9,420,572	$6,227	$12,828	$4,442	$28,587	$4,550	$123,234	$75,068
	1907	5	7,048,370	6,943,683	9,069	1,871	4,915	...	...	60,656	28,176
	1902	5	3,727,648	3,650,483	4,138	...	4,335	...	...	49,680	19,012
Iowa	1912	24	7,372,945	5,259,416	4,578	562,236	17,691	42,527	72,762	1,144,220	269,515
	1907	24	4,295,930	3,415,603	1,435	173,415	6,831	12,109	...	579,115	107,422
	1902	22	2,384,421	1,959,965	954	17,548	5,299	9,132	...	296,730	94,793
Missouri	1912	19	21,115,228	20,215,633	18,003	55,366	74,476	29,446	1,000	551,422	169,882
	1907	14	18,000,248	17,266,141	13,605	34,300	67,945	15,772	...	452,174	150,311
	1902	16	10,691,220	10,422,536	5,652	7,379	41,071	4,392	...	172,036	38,154
North Dakota and South Dakota.[5]	1912	5	238,587	221,590	47	12,596	150	...	...	...	4,204
	1907	5	112,079	100,273	...	...	613	...	...	...	11,193
Nebraska	1912	7	3,577,746	3,277,008	2,483	...	27,512	8,996	18,754	130,958	112,035
	1907	8	2,737,756	2,584,425	3,435	754	9,285	4,599	...	84,041	51,217
	1902	4	1,148,994	1,107,494	1,044	...	2,698	...	...	35,073	2,685
Kansas	1912	21	2,901,310	2,459,743	9,496	84,249	2,526	21,673	17,657	283,522	22,444
	1907	17	1,439,813	1,268,709	3,128	19,481	1,974	2,005	...	136,736	7,780
	1902	11	370,481	343,197	200	...	566	...	...	23,007	3,511
SOUTH ATLANTIC:											
Delaware, Maryland, and District of Columbia.	1912	25	16,619,698	15,480,227	36,621	150,108	43,607	52,300	12,385	622,393	222,057
	1907	23	12,373,382	11,920,958	5,003	43,318	49,039	15,708	...	214,123	125,233
	1902	21	8,393,725	8,076,302	10,443	18,580	42,168	11,169	...	67,795	167,268
Virginia	1912	18	6,847,216	4,531,942	7,979	160,429	6,190	23,913	12,030	2,007,620	97,113
	1907	22	5,152,173	3,531,681	6,390	70,356	4,184	100	...	1,437,087	102,375
	1902	16	1,553,478	1,103,732	2,036	12,791	1,617	368	...	387,031	45,903
West Virginia	1912	21	3,615,257	3,034,495	3,371	69,157	3,719	65,032	5,989	386,598	46,896
	1907	15	2,562,800	2,139,823	1,925	18,372	1,631	35,100	...	333,565	32,384
	1902	8	1,102,171	958,805	100	6,160	755	...	...	126,117	10,234
North Carolina	1912	13	2,127,884	1,176,841	652	62,979	1,009	4,665	20,765	833,480	27,493
	1907	11	1,186,469	680,472	845	14,953	453	2,358	...	473,651	13,737
	1902	7	437,259	247,812	75	8,367	...	1,500	...	163,657	15,848
South Carolina	1912	6	1,345,450	928,847	278	31,416	2,682	602	32	372,768	8,825
	1907	7	1,273,617	793,956	1,186	17,384	856	10,376	...	437,483	12,376
	1902	7	597,577	401,553	61	16,579	1,504	...	...	171,562	6,318
Georgia	1912	14	6,934,010	4,394,781	10,379	34,355	2,200	40,038	8,385	2,305,083	138,789
	1907	12	4,616,337	2,962,857	7,592	31,574	2,919	12,487	...	1,484,966	113,942
	1902	10	2,375,224	1,594,982	4,972	9,772	440	150	...	727,847	37,061
Florida	1912	10	1,968,990	1,374,257	1,584	11,351	903	3,153	342	561,416	15,984
	1907	10	1,367,210	955,360	2,140	14,656	842	204	...	375,691	18,317
	1902	6	529,743	411,533	667	2,486	515	...	...	110,363	4,179
EAST SOUTH CENTRAL:											
Kentucky	1912	10	5,919,344	5,592,234	3,815	40,996	3,134	96,864	3,285	103,324	75,692
	1907	13	4,776,098	4,441,781	7,319	52,339	2,546	...	...	160,629	111,484
	1902	12	2,932,901	2,780,487	1,407	2,500	2,168	4,162	...	133,337	8,840
Tennessee	1912	12	6,124,678	4,664,550	1,813	34,082	9,380	1,932	17,753	1,372,745	22,423
	1907	9	4,443,891	3,698,013	5,833	4,508	7,967	...	...	701,683	25,887
	1902	8	1,866,835	1,759,680	68	1,239	4,836	...	...	86,901	14,111
Alabama	1912	11	4,140,937	3,004,002	5,612	83,406	3,060	4,055	7,559	1,017,134	16,109
	1907	10	3,365,979	2,577,777	6,304	78,530	2,622	282	...	671,425	29,039
	1902	9	1,497,351	1,135,266	2,211	34,494	1,415	1,362	...	318,660	3,943
Mississippi	1912	12	899,524	607,723	...	13,276	175	...	422	273,217	4,711
	1907	8	817,769	488,084	143	18,733	400	833	...	308,053	1,523
	1902	5	258,654	154,597	113	...	...	...	...	103,236	708
WEST SOUTH CENTRAL:											
Arkansas	1912	10	1,831,185	1,183,389	3,020	2,812	240	...	4,804	612,953	23,967
	1907	8	1,215,954	824,335	1,001	444	240	245	...	383,225	6,464
	1902	7	371,560	322,805	114	26	...	...	...	45,630	2,985
Louisiana	1912	13	5,312,372	4,725,416	5,054	2,122	1,454	432	4,318	549,047	24,529
	1907	11	4,508,104	4,284,357	5,604	...	1,740	...	...	191,728	24,675
	1902	8	2,910,244	2,835,262	4,457	...	1,682	...	...	37,753	31,090
Oklahoma[6]	1912	17	1,445,842	1,253,482	1,403	31,487	1,076	7,576	7,394	130,096	13,328
	1907	8	564,196	529,455	942	12,182	674	798	...	16,708	3,437
Texas	1912	39	8,441,111	7,628,119	18,566	7,086	3,046	16,727	21,020	568,641	177,906
	1907	23	4,856,640	4,245,500	6,385	1,565	2,932	7,106	...	510,757	82,395
	1902	17	1,547,846	1,501,188	2,250	3,000	555	719	...	20,859	19,275
MOUNTAIN:											
Montana	1912	6	1,055,283	800,150	...	1,516	...	...	775	242,305	10,537
	1907	5	760,201	613,251	...	54,575	...	...	...	77,993	14,382
	1902	5	492,023	382,452	...	50,544	365	34	...	43,284	15,344

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[1] Reported as "chartered cars" in 1907 and 1902.
[2] Reported as "express" in 1907 and 1902.
[3] Included with revenues from "miscellaneous sources" in 1907 and 1902
[4] Reported as revenues from "miscellaneous sources" in 1907 and 1902.
[5] No company reported in 1902 for North Dakota, and the 1 company in South Dakota in 1902 failed to furnish this information.
[6] No company reported in 1902.

TABLE 161.—OPERATING REVENUES, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902—Continued.

DIVISION AND STATE.	Census.	Number of companies.	Total operating revenue.	Passenger.	Parlor, chair, and special car.[1]	Freight.	Mail.	Baggage, express, and milk.[2]	Other transportation revenue.[3]	Sale of electric current.	Other nontransportation revenue.[4]
MOUNTAIN—Continued.											
Colorado	1912	16	$5,829,146	$4,521,013	$22,273	$47,915	$2,144	$10,486	$13,915	$1,064,247	$147,153
	1907	11	4,130,962	3,696,500	15,887	55,856	1,584			344,468	16,667
	1902	7	2,227,286	2,091,824	8,106		2,000			111,104	14,252
All other Mountain states	1912	18	4,218,190	2,739,694	4,361	77,201	2,807	40,397	6,871	1,321,721	25,138
Idaho, Wyoming, Nevada, and Utah	1912	12	3,873,085	2,458,252	4,181	76,203	2,557	39,902	6,261	1,266,588	19,141
New Mexico and Arizona	1912	6	345,105	281,442	180	998	250	495	610	55,133	5,997
All other Mountain states[5]	1907	12	2,284,737	1,316,604	6,883	17,801	1,138	1,503		921,526	19,282
	1902	6	587,705	572,970	1,197		800			2,216	10,522
PACIFIC:											
Washington	1912	19	12,706,499	7,282,685	33,001	677,472	19,842	51,753	20,763	4,422,080	198,903
	1907	14	7,898,743	6,070,685	15,980	529,567	9,150	16,060		1,182,423	74,878
	1902	8	2,542,906	1,813,156	3,233	63,501	1,883			641,800	19,333
Oregon	1912	6	7,700,119	4,578,419	14,332	511,634	6,744	57,398	29,171	2,327,822	174,609
	1907	8	2,731,674	2,529,990		164,551	6,690	600			29,843
	1902	6	1,042,895	969,231	507	17,287	2,904	163		33,522	19,281
California	1912	35	34,080,579	31,013,722	50,379	1,661,278	37,288	207,901	323,928	75,817	710,266
	1907	41	20,691,713	19,233,083	75,059	600,818	26,283	97,346		366,566	292,558
	1902	35	9,967,288	9,464,723	3,637	47,625	20,116	3,576		279,216	148,395

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[1] Reported as "chartered cars" in 1907 and 1902.

[2] Reported as "express" in 1907 and 1902.

[3] Included with revenues from "miscellaneous sources" in 1907 and 1902.

[4] Reported as revenues from "miscellaneous sources" in 1907 and 1902.

[5] Includes states and territories as follows: 1907—Arizona, Idaho, Nevada, New Mexico, and Utah. 1902—Arizona, Idaho, New Mexico, and Utah.

Table 162.—OPERATING EXPENSES, BY ACCOUNTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902.

DIVISION AND STATE.	Census.	Number of operating companies.	Total operating expenses.	Way and structures.	Equipment.	Traffic.	CONDUCTING TRANSPORTATION.				General and miscellaneous.	Wages, supplies, and expenses incident to electric service not elsewhere included.
							Total.	Superintendence of transportation.	Power.	Operation of cars.		
UNITED STATES	1912	975	$332,896,356	$46,371,685	$40,056,378	$2,606,057	$189,689,432	$7,127,204	$60,484,917	$122,077,311	$54,172,804	....
	1907	[1] 939	251,309,252	28,520,925	31,485,810	1,730,851	141,095,350	3,545,418	43,972,669	93,577,263	42,307,443	$6,168,873
	1902	[2] 799	142,312,597	13,600,236	16,676,532	1,122,816	84,035,067	2,598,935	23,062,328	58,373,804	24,689,193	2,188,753
GEOGRAPHIC DIVISIONS:												
New England	1912	91	37,316,197	5,512,046	4,775,073	273,873	20,932,057	756,319	6,143,461	14,032,277	5,823,148	....
	1907	118	31,471,822	4,096,186	3,888,876	349,393	17,590,924	453,671	5,492,244	11,645,009	4,925,813	620,630
	1902	137	22,877,440	2,743,368	2,627,529	205,490	13,254,905	734,036	3,685,157	8,835,712	3,769,326	276,822
Middle Atlantic	1912	246	108,656,704	15,196,953	13,932,504	514,806	61,440,393	2,887,596	17,988,021	40,564,776	17,572,048	....
	1907	247	84,837,741	9,675,264	11,281,813	274,020	48,561,093	1,346,047	14,265,693	32,949,353	14,700,635	344,916
	1902	219	53,626,649	4,804,948	6,385,445	319,014	32,095,680	1,059,284	8,076,845	22,959,551	9,826,039	195,523
East North Central	1912	222	78,747,118	9,782,125	8,741,177	543,599	47,626,604	1,300,093	15,865,913	30,460,598	12,053,613	....
	1907	220	60,170,744	6,610,803	7,130,850	293,608	34,115,982	685,194	11,205,813	22,224,975	10,577,744	1,441,757
	1902	177	31,105,834	2,765,110	3,758,645	182,390	18,293,597	321,392	5,384,707	12,587,498	5,563,714	542,378
West North Central	1912	85	27,363,397	4,390,762	3,487,192	194,603	14,773,377	484,917	4,942,168	9,346,292	4,517,463	....
	1907	73	18,204,188	1,675,071	2,089,896	182,300	10,679,902	289,359	3,371,743	7,018,800	3,276,627	300,392
	1902	58	10,165,628	888,535	1,237,861	100,059	5,997,577	122,484	1,694,422	4,180,671	1,800,769	140,827
South Atlantic	1912	107	21,591,731	3,044,858	2,107,036	222,296	12,012,821	519,246	4,387,003	7,106,572	4,204,720	....
	1907	100	16,280,864	1,587,851	1,631,473	172,122	8,621,584	218,180	3,059,854	5,343,550	2,661,851	1,605,983
	1902	75	8,186,047	508,447	849,231	111,354	4,713,132	110,322	1,546,103	3,056,707	1,398,019	605,864
East South Central	1912	45	9,867,378	1,308,182	1,205,036	59,930	5,172,936	224,478	1,834,205	3,114,253	2,121,294	....
	1907	40	8,070,391	841,792	792,400	75,842	4,116,775	154,584	1,403,020	2,559,171	1,589,429	654,153
	1902	34	3,709,854	439,277	400,996	31,999	1,909,316	105,555	524,614	1,279,147	692,712	235,564
West South Central	1912	79	10,390,837	1,178,911	1,151,899	116,997	5,888,213	214,338	2,120,747	3,553,128	2,054,817	....
	1907	50	6,816,880	670,030	772,135	114,562	3,749,898	82,093	1,292,528	2,375,277	1,105,341	404,914
	1902	32	2,969,022	312,381	373,921	28,605	1,804,395	29,499	527,648	1,247,248	444,368	5,352
Mountain	1912	40	6,426,225	855,554	679,832	97,272	3,776,552	84,429	1,585,553	2,106,570	1,017,015	....
	1907	28	4,099,483	518,090	502,393	78,493	2,246,500	51,256	726,804	1,468,440	593,971	160,036
	1902	18	2,039,948	301,703	198,998	73,091	1,182,980	23,732	360,577	798,671	257,166	26,010
Pacific	1912	60	32,536,769	5,102,294	3,976,629	582,681	18,066,479	655,788	5,617,846	11,792,845	4,808,686	....
	1907	63	21,357,139	2,845,838	3,395,974	190,511	11,412,692	265,034	3,154,970	7,992,688	2,876,032	636,092
	1902	49	7,632,175	836,467	843,906	70,814	4,783,485	92,631	1,262,255	3,428,599	937,080	160,423
NEW ENGLAND:												
Maine	1912	16	2,002,617	284,734	243,683	26,871	1,116,900	26,612	448,202	642,086	330,429	....
	1907	17	1,480,544	202,968	176,594	31,438	812,415	17,947	307,076	487,392	215,231	41,898
	1902	19	1,127,660	160,610	157,745	45,130	562,284	18,059	200,531	343,694	152,663	49,228
New Hampshire	1912	13	987,934	159,640	131,203	15,737	552,188	24,404	248,159	279,625	129,166	....
	1907	16	895,862	122,072	91,367	29,806	474,386	16,252	213,171	244,963	175,300	2,931
	1902	7	478,849	40,711	48,540	16,288	291,812	7,549	134,413	149,850	79,011	2,487
Vermont	1912	9	345,268	61,141	57,032	7,208	151,826	6,739	46,158	98,929	68,061	....
	1907	10	313,845	49,827	37,516	5,708	167,681	6,961	67,087	93,633	53,113	....
	1902	9	201,179	28,697	20,705	3,629	129,576	5,210	41,449	82,917	18,572	....
Massachusetts	1912	43	24,889,596	3,615,816	3,172,557	175,758	13,909,741	561,994	3,758,140	9,589,607	4,015,724	....
	1907	62	21,179,642	2,521,961	2,685,026	184,255	12,204,200	322,901	3,689,680	8,191,619	3,530,122	54,078
	1902	74	16,403,667	1,806,596	1,895,793	92,324	9,725,188	640,791	2,573,845	6,510,552	2,841,003	42,763
Rhode Island and Connecticut.	1912	10	9,090,782	1,390,715	1,170,598	48,299	5,201,402	136,570	1,642,802	3,422,030	1,279,768	....
	1907	13	7,601,929	1,199,358	898,373	98,186	3,932,242	89,610	1,215,230	2,627,402	952,047	521,723
	1902	28	4,666,085	706,754	504,746	48,119	2,546,045	62,427	734,919	1,748,699	678,077	182,344
MIDDLE ATLANTIC:												
New York	1912	101	66,401,113	9,101,193	9,306,172	256,165	36,980,094	1,888,496	10,976,574	24,115,024	10,757,489	....
	1907	101	50,928,855	5,453,039	7,068,741	134,684	29,070,621	844,654	8,556,144	19,669,823	8,970,125	231,645
	1902	96	33,677,724	2,727,448	3,771,757	111,378	20,363,935	721,152	5,266,237	14,376,546	6,521,514	181,692
New Jersey	1912	24	10,552,653	1,733,090	1,234,938	26,049	5,955,622	365,357	1,718,517	3,871,748	1,602,954	....
	1907	24	7,905,138	604,494	1,229,375	18,561	4,617,937	153,335	1,635,249	2,829,353	1,432,536	2,235
	1902	25	4,324,112	299,806	576,440	15,660	2,631,836	56,302	753,759	1,821,775	788,891	11,479
Pennsylvania	1912	121	31,702,938	4,362,670	3,391,394	232,592	18,504,677	633,743	5,292,930	12,578,004	5,211,605	....
	1907	122	26,003,748	3,617,731	2,983,697	120,775	14,872,535	348,058	4,074,300	10,450,177	4,297,974	111,036
	1902	98	15,624,813	1,777,694	2,037,248	191,976	9,099,909	281,830	2,056,849	6,761,230	2,515,634	2,352
EAST NORTH CENTRAL:												
Ohio	1912	75	24,543,633	3,655,805	3,061,946	170,308	14,047,574	485,394	4,737,502	8,824,678	3,608,000	....
	1907	73	18,479,609	2,188,337	2,486,726	61,245	10,284,474	267,641	3,411,273	6,605,560	2,824,831	633,996
	1902	62	9,132,480	871,448	863,348	58,975	5,743,234	113,153	1,616,321	4,013,760	1,494,674	100,801
Indiana	1912	34	9,132,539	1,491,836	1,100,299	100,915	4,805,932	150,178	1,912,598	2,743,156	1,633,557	....
	1907	33	6,308,152	667,792	763,452	56,503	3,327,708	75,555	1,291,281	1,960,872	1,332,106	160,591
	1902	26	2,219,791	212,533	305,976	31,887	1,193,404	27,146	363,879	802,379	376,587	99,404
Illinois	1912	67	29,822,058	2,505,728	2,809,217	128,427	19,913,993	359,089	6,507,267	13,047,637	4,464,693	....
	1907	70	25,597,996	2,755,147	2,807,087	113,802	14,913,063	202,484	4,744,442	9,966,137	4,907,847	101,050
	1902	48	14,103,211	1,182,824	1,999,348	28,645	8,049,012	89,704	2,353,311	5,605,997	2,790,614	52,768
Michigan	1912	22	11,142,975	1,731,826	1,328,692	121,136	6,293,176	230,691	1,832,562	4,229,923	1,668,145	....
	1907	24	6,549,919	722,055	770,541	52,485	3,910,144	88,219	1,229,521	2,592,404	973,936	120,758
	1902	24	3,655,328	347,646	424,800	56,524	2,213,419	56,533	660,257	1,496,629	601,175	11,764
Wisconsin	1912	24	4,105,913	396,930	441,023	22,813	2,565,929	74,741	875,984	1,615,204	679,218	....
	1907	20	3,235,068	277,472	303,044	9,573	1,680,593	51,295	529,296	1,100,002	539,024	425,362
	1902	17	1,995,024	150,659	165,173	6,359	1,094,528	34,856	390,939	668,733	300,664	277,641

[1] Exclusive of 6 companies which failed to furnish this information.

[2] Exclusive of 18 companies which failed to furnish this information.

Table 162.—OPERATING EXPENSES, BY ACCOUNTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902—Continued.

DIVISION AND STATE.	Census.	Number of operating companies.	Total operating expenses.	Way and structures.	Equipment.	Traffic.	CONDUCTING TRANSPORTATION.				General and miscellaneous.	Wages, supplies, and expenses incident to electric service not elsewhere included.
							Total.	Superintendence of transportation.	Power.	Operation of cars.		
West North Central:												
Minnesota	1912	9	$5,882,755	$851,488	$808,630	$43,115	$3,255,060	$177,088	$900,350	$2,177,622	$924,462	....
	1907	5	3,524,346	259,326	321,462	58,852	2,160,682	95,701	598,449	1,466,532	680,916	$43,108
	1902	5	1,719,687	109,740	221,043	6,195	1,031,147	21,488	263,689	745,970	321,765	29,797
Iowa	1912	24	4,520,635	448,766	362,571	76,926	2,590,944	70,280	988,916	1,531,748	1,041,428	....
	1907	24	2,826,959	235,789	240,922	54,145	1,607,317	32,654	601,440	973,223	464,561	224,225
	1902	22	1,460,993	167,524	156,305	40,183	798,988	13,192	293,226	492,570	219,621	78,372
Missouri	1912	19	13,070,500	2,600,031	1,841,322	28,063	6,665,128	195,022	2,249,617	4,220,489	1,935,956	....
	1907	14	9,680,226	953,887	1,326,580	36,129	5,583,070	126,226	1,759,902	3,696,942	1,751,751	28,809
	1902	16	6,071,971	459,948	767,517	50,227	3,638,488	80,849	970,997	2,586,642	1,129,412	26,379
North Dakota and South Dakota.	1912	5	162,123	8,456	11,984	340	107,261	579	39,231	67,451	34,082	....
	1907	5	72,412	6,836	5,102	624	48,221	331	16,788	31,102	11,629	....
	[1] 1902	....	....	....	....	....	....	....	....	....	....	....
Nebraska	1912	7	2,021,647	297,362	263,665	18,254	1,151,760	27,097	331,336	793,327	290,606	....
	1907	8	1,325,038	137,882	116,898	15,927	810,882	22,526	206,558	581,798	243,449	....
	1902	4	655,729	123,837	63,765	....	384,755	1,875	122,058	260,822	83,372	....
Kansas	1912	21	1,705,737	184,659	199,020	27,905	1,003,224	14,851	432,718	555,655	290,929	....
	1907	17	775,207	81,351	78,932	16,623	469,730	11,921	188,606	269,203	124,321	4,250
	1902	11	257,248	27,486	29,231	3,454	144,199	5,080	44,452	94,667	46,599	6,279
South Atlantic:												
Delaware, Maryland, and District of Columbia.	1912	25	8,718,499	1,222,116	969,250	85,178	5,051,401	254,811	1,346,745	3,449,845	1,390,554	....
	1907	23	6,460,116	551,059	774,272	32,489	3,973,401	99,880	1,285,138	2,588,383	1,128,895	....
	1902	21	4,231,128	221,751	510,230	24,531	2,700,350	49,075	829,243	1,822,032	767,359	6,907
Virginia	1912	18	3,875,733	687,181	357,924	47,102	1,954,762	78,186	755,200	1,121,376	828,764	....
	1907	22	3,261,570	332,253	265,926	52,828	1,538,643	39,451	604,360	894,832	503,914	568,006
	1902	16	1,009,356	96,276	98,804	24,531	559,931	17,734	243,083	299,114	180,420	49,394
West Virginia	1912	21	1,910,770	304,645	188,683	19,437	1,061,763	28,827	395,181	637,755	336,242	....
	1907	15	1,540,395	282,940	129,769	16,193	830,061	11,426	298,751	519,884	218,444	62,988
	1902	8	652,862	52,897	48,669	1,715	371,946	6,582	97,029	268,335	104,992	72,643
North Carolina	1912	13	1,416,802	137,689	130,219	32,363	809,721	10,543	490,669	308,509	306,810	....
	1907	11	743,357	50,678	56,874	20,291	341,977	10,971	170,665	160,341	118,034	155,503
	1902	7	322,344	30,501	28,215	13,133	156,772	4,288	78,996	73,488	44,002	49,721
South Carolina	1912	6	914,391	87,812	59,311	4,540	583,312	18,856	297,109	267,347	179,416	....
	1907	7	762,853	88,052	98,407	19,994	395,652	16,463	185,399	193,790	138,281	22,467
	1902	7	398,662	26,349	35,435	11,122	188,485	16,906	55,636	115,943	57,294	79,977
Georgia	1912	14	3,600,445	476,127	288,201	29,904	1,933,695	97,848	865,759	970,088	872,518	....
	1907	12	2,555,713	226,838	208,733	24,121	1,139,516	22,325	371,724	745,467	403,788	552,717
	1902	10	1,232,320	57,535	101,608	28,297	570,344	9,451	176,835	384,058	189,838	284,698
Florida	1912	10	1,155,091	129,288	113,448	3,772	618,167	30,175	236,340	351,652	290,416	....
	1907	10	956,860	56,031	97,492	6,206	402,334	17,664	143,817	240,853	150,495	244,302
	1902	6	339,375	23,138	26,270	8,025	165,304	6,286	65,281	93,737	54,114	62,524
East South Central:												
Kentucky	1912	10	3,556,537	622,648	380,750	10,340	1,804,124	92,024	492,244	1,219,856	738,675	....
	1907	13	2,825,497	407,510	266,893	15,273	1,463,450	65,284	378,188	1,019,978	608,279	64,092
	1902	12	1,560,270	243,811	145,385	14,344	829,793	58,187	184,764	586,842	299,166	27,771
Tennessee	1912	12	3,257,823	288,028	419,222	32,986	1,711,764	77,981	622,411	1,011,372	805,823	....
	1907	9	2,434,252	137,639	241,226	23,386	1,302,141	44,190	434,437	823,514	474,106	255,754
	1902	8	1,079,237	101,335	126,352	4,010	568,343	25,700	163,842	378,801	233,724	45,473
Alabama	1912	11	2,401,152	307,934	322,859	16,007	1,286,392	44,628	523,498	718,266	467,960	....
	1907	10	2,276,100	230,454	227,241	34,095	1,034,358	37,877	403,489	592,992	415,645	334,307
	1902	9	878,291	76,544	114,402	11,078	409,590	20,273	114,063	275,254	113,027	153,650
Mississippi	1912	12	651,866	89,572	82,205	597	370,656	9,845	196,052	164,759	108,836	....
	1907	8	534,542	66,189	57,040	3,088	316,826	7,233	186,906	122,687	91,399	....
	1902	5	192,056	17,587	14,857	2,567	101,590	1,395	61,945	38,250	46,795	8,660
West South Central:												
Arkansas	1912	10	1,001,342	84,576	143,755	11,668	563,939	14,902	243,933	305,104	197,404	....
	1907	8	683,262	40,529	62,403	16,902	321,962	13,907	113,805	194,250	107,634	133,832
	1902	7	216,433	19,601	19,405	569	142,317	2,551	55,129	84,637	32,986	1,555
Louisiana	1912	13	3,232,460	419,819	397,227	44,040	2,047,945	67,316	699,371	1,281,258	323,429	....
	1907	11	2,682,481	281,361	380,784	63,913	1,590,430	32,260	486,384	1,071,786	296,443	69,550
	1902	8	1,758,989	174,383	244,121	13,109	1,115,560	10,610	295,083	809,867	208,019	3,797
Oklahoma	1912	17	970,447	105,923	92,494	5,903	569,538	17,101	216,903	335,534	196,589	....
	1907	8	357,917	40,094	35,756	3,142	226,013	3,123	87,434	135,456	52,912	....
	[2] 1902	....	....	....	....	....	....	....	....	....	....	....
Texas	1912	39	5,186,588	568,593	518,423	55,386	2,706,791	115,019	960,540	1,631,232	1,337,395	....
	1907	23	3,093,220	308,046	293,192	30,605	1,611,493	32,803	604,905	973,785	648,352	201,532
	1902	17	993,600	118,397	110,395	14,927	546,518	16,338	177,436	352,744	203,363	....

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[1] No company reported in 1902 for North Dakota, and the 1 company in South Dakota in 1902 failed to furnish this information.

[2] No company reported in 1902.

TABLE 162.—OPERATING EXPENSES, BY ACCOUNTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902—Continued.

DIVISION AND STATE.	Census.	Number of operating companies.	Total operating expenses.	Way and structures.	Equipment.	Traffic.	CONDUCTING TRANSPORTATION.				General and miscellaneous.	Wages, supplies, and expenses incident to electric service not elsewhere included.
							Total.	Superintendence of transportation.	Power.	Operation of cars.		
MOUNTAIN:												
Montana	1912	6	$770,586	$79,593	$65,655	$53,715	$413,141	$4,316	$120,769	$288,056	$158,482	....
	1907	5	551,933	56,905	55,058	47,594	277,692	1,695	58,182	217,815	70,356	$44,328
	1902	5	365,073	45,118	28,317	39,150	193,160	600	58,983	133,577	37,588	21,740
Colorado	1912	16	3,264,753	411,901	318,575	32,981	1,938,760	47,281	753,168	1,138,311	562,536	....
	1907	11	2,099,421	191,227	258,731	23,293	1,210,218	25,479	354,025	830,714	339,814	76,138
	1902	7	1,300,606	198,662	128,618	32,959	760,376	16,032	240,298	504,046	175,721	4,270
All other Mountain states	1912	18	2,390,886	364,060	295,602	10,576	1,424,651	32,832	711,616	680,203	295,997	....
Idaho, Wyoming, Nevada, and Utah	1912	12	2,097,899	304,643	247,713	9,004	1,274,500	27,820	636,951	609,729	262,030	....
New Mexico and Arizona	1912	6	292,987	59,417	47,889	1,572	150,151	5,012	74,665	70,474	33,958	....
All other Mountain states.[1]	1907	12	1,448,129	269,958	188,604	7,606	758,590	24,082	314,597	419,911	183,801	39,570
	1902	6	374,269	57,923	42,063	982	229,444	7,100	61,296	161,048	43,857	....
PACIFIC:												
Washington	1912	19	7,116,198	1,083,540	905,733	54,347	3,576,314	114,831	1,370,862	2,090,621	1,496,264	....
	1907	14	5,140,501	504,539	546,373	23,765	2,447,832	55,379	595,131	1,797,322	996,966	621,026
	1902	8	1,576,018	193,774	155,767	32,957	782,791	9,980	274,662	498,149	278,333	152,396
Oregon	1912	6	3,736,259	428,537	394,687	47,977	1,998,388	83,835	540,771	1,373,782	866,670	....
	1907	8	1,638,271	183,500	201,920	6,517	973,244	10,452	169,846	792,946	273,090	....
	1902	6	653,912	74,905	86,486	2,310	396,906	9,405	108,877	278,624	85,278	8,027
California	1912	35	21,684,312	3,590,217	2,676,209	480,357	12,491,777	457,122	3,706,213	8,328,442	2,445,752	....
	1907	41	14,578,367	2,157,799	2,647,681	160,229	7,991,616	199,203	2,389,993	5,402,420	1,605,976	15,066
	1902	35	5,402,245	567,788	621,653	35,547	3,603,788	73,246	878,716	2,651,826	573,469	....

[1] Includes states and territories as follows: 1907—Arizona, 4; Idaho, 2; Nevada, 1; New Mexico, 2; Utah, 3. 1902—Arizona, 1; Idaho, 1; New Mexico, 1; Utah, 3.

Table 163.—OPERATING EXPENSES, BY DETAILED

	DIVISION AND STATE.	Number of companies.	Total operating expenses.	WAY AND STRUCTURES.						
				Total.	Superintendence of way and structures.	Maintenance of way.	Maintenance of electric lines.	Buildings and structures.	Depreciation of way and structures.	Other operations.[1]
1	United States	975	$332,896,356	$46,371,685	$2,579,774	$30,162,653	$5,513,272	$2,674,899	$3,705,511	$1,735,576
	Geographic divisions:									
2	New England	91	37,316,197	5,512,046	281,762	3,987,658	734,101	422,002	16,184	70,339
3	Middle Atlantic	246	108,656,704	15,196,953	985,262	10,312,190	1,723,244	1,114,138	947,224	114,895
4	East North Central	222	78,747,118	9,782,125	551,309	6,879,162	1,216,188	548,038	196,828	390,600
5	West North Central	85	27,363,397	4,390,762	163,037	2,185,481	359,609	165,552	1,475,552	41,531
6	South Atlantic	107	21,591,731	3,044,858	168,748	1,517,413	437,509	94,976	333,906	492,306
7	East South Central	45	9,867,378	1,308,182	42,757	819,438	229,460	50,165	105,461	60,901
8	West South Central	79	10,390,837	1,178,911	71,568	750,464	164,167	41,900	76,755	74,057
9	Mountain	40	6,426,225	855,554	58,431	450,920	82,195	52,108	29,833	182,067
10	Pacific	60	32,536,769	5,102,294	256,900	3,259,927	566,799	186,020	523,768	308,880
	New England:									
11	Maine	16	2,002,617	284,734	7,637	167,938	38,632	13,180	12,000	45,347
12	New Hampshire	13	987,934	159,640	6,037	129,878	16,745	6,980	....	....
13	Vermont	9	345,268	61,141	3,574	41,596	5,569	2,375	....	8,027
14	Massachusetts	43	24,889,596	3,615,816	204,463	2,617,553	500,484	278,618	4,184	10,514
15	Rhode Island and Connecticut	10	9,090,782	1,390,715	60,051	1,030,693	172,671	120,849	....	6,451
	Middle Atlantic:									
16	New York	101	66,401,113	9,101,193	645,060	5,949,966	1,030,853	772,114	662,235	40,965
17	New Jersey	24	10,552,653	1,733,090	127,862	1,128,416	145,793	62,982	222,615	45,422
18	Pennsylvania	121	31,702,938	4,362,670	212,340	3,233,808	546,598	279,042	62,374	28,508
	East North Central:									
19	Ohio	75	24,543,633	3,655,805	261,944	2,407,239	473,757	126,304	137,973	248,588
20	Indiana	34	9,132,539	1,491,836	75,270	1,102,585	210,915	71,228	2,752	29,086
21	Illinois	67	29,822,058	2,505,728	103,904	1,734,316	296,779	257,175	25,123	88,431
22	Michigan	22	11,142,975	1,731,826	85,570	1,366,595	156,822	70,214	29,748	22,877
23	Wisconsin	24	4,105,913	396,930	24,621	268,427	77,915	23,117	1,232	1,618
	West North Central:									
24	Minnesota	9	5,882,755	851,488	20,368	325,719	45,294	33,228	411,223	15,656
25	Iowa	24	4,520,635	448,766	24,408	316,492	71,797	17,898	316	17,855
26	Missouri	19	13,070,500	2,600,031	91,664	1,324,148	187,403	97,592	899,224	....
27	North Dakota and South Dakota	5	162,123	8,456	240	6,298	1,477	441	....	....
28	Nebraska	7	2,021,647	297,362	12,915	89,349	25,817	9,481	159,800	....
29	Kansas	21	1,705,737	184,659	13,442	123,475	27,821	6,912	4,989	8,020
	South Atlantic:									
30	Delaware, Maryland, and District of Columbia	25	8,718,499	1,222,116	83,501	674,833	156,553	48,240	257,171	1,818
31	Virginia	18	3,875,733	687,181	40,086	278,992	98,396	14,959	62,858	191,890
32	West Virginia	21	1,910,770	304,645	20,413	209,159	57,799	8,505	2,439	6,330
33	North Carolina	13	1,416,802	137,689	6,843	54,454	16,726	6,551	11,438	41,677
34	South Carolina	6	914,391	87,812	4,236	59,579	19,832	4,165	....	....
35	Georgia	14	3,600,445	476,127	10,845	190,744	67,484	7,663	....	199,391
36	Florida	10	1,155,091	129,288	2,824	49,652	20,719	4,893	....	51,200
	East South Central:									
37	Kentucky	10	3,556,537	622,648	18,113	483,569	56,955	17,441	46,570	....
38	Tennessee	12	3,257,823	288,028	13,520	174,478	63,567	20,573	9,250	6,640
39	Alabama	11	2,401,152	307,934	8,905	124,860	87,096	10,137	37,667	39,269
40	Mississippi	12	651,866	89,572	2,219	36,531	21,842	2,014	11,974	14,992
	West South Central:									
41	Arkansas	10	1,001,342	84,576	2,654	34,468	12,996	2,405	6,903	25,150
42	Louisiana	13	3,232,460	419,819	16,488	263,374	72,272	20,487	40,487	6,711
43	Oklahoma	17	970,447	105,923	8,508	65,574	11,947	2,720	15,141	2,033
44	Texas	39	5,186,588	568,593	43,918	387,048	66,952	16,288	14,224	40,163
	Mountain:									
45	Montana	6	770,586	79,593	3,618	50,831	5,847	1,395	11,587	6,315
46	Colorado	16	3,264,753	411,901	34,810	217,805	41,527	27,639	499	89,621
47	Idaho, Wyoming, Utah, and Nevada	12	2,097,899	304,643	17,575	144,292	28,643	21,760	6,242	86,131
48	New Mexico and Arizona	6	292,987	59,417	2,428	37,992	6,178	1,314	11,505	....
	Pacific:									
49	Washington	19	7,116,198	1,083,540	44,296	494,491	85,524	20,430	183,757	255,042
50	Oregon	6	3,736,259	428,537	22,301	257,495	72,972	17,616	4,315	53,838
51	California	35	21,684,312	3,590,217	190,303	2,507,941	408,303	147,974	335,696	....

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[1] Expenses of light and power departments not distributed among prior accounts.

ACCOUNTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

EQUIPMENT.								Traffic expenses.	CONDUCTING TRANSPORTATION.					
											Power.			
Total.	Superintendence of equipment.	Maintenance of power equipment.	Maintenance of cars and locomotives.	Maintenance of electric equipment of cars and locomotives.	Miscellaneous equipment expenses.	Depreciation of equipment.	Other operations.[1]		Total.	Superintendence of transportation.	Total.	Power-plant employees.	Substation employees.	
$40,056,378	$1,672,393	$3,769,735	$16,936,623	$9,877,340	$3,039,164	$3,670,376	$1,090,747	$2,606,057	$189,689,432	$7,127,204	$60,484,917	$6,325,506	$1,831,196	1
4,775,073	221,197	681,065	2,007,375	1,485,338	306,537	20,972	52,589	273,873	20,932,057	756,319	6,143,461	869,124	112,711	2
13,932,504	572,975	1,267,389	5,802,435	3,518,459	1,195,202	1,445,727	130,317	514,806	61,440,398	2,887,596	17,988,021	2,200,544	610,588	3
8,741,177	378,007	902,493	4,078,181	2,285,980	638,109	155,112	303,295	543,599	47,626,604	1,300,093	15,865,913	1,585,793	514,968	4
3,487,192	106,169	254,673	1,175,770	725,044	240,263	968,579	16,694	194,603	14,773,377	484,917	4,942,168	521,928	100,622	5
2,107,036	102,995	175,026	862,648	416,728	134,898	244,150	170,591	222,296	12,012,821	519,246	4,387,003	444,172	107,047	6
1,205,036	41,208	128,323	476,402	242,815	58,538	171,935	85,815	59,930	5,172,936	224,478	1,834,205	233,639	14,083	7
1,151,899	60,707	121,287	530,498	259,737	80,244	51,906	47,520	116,997	5,888,213	214,338	2,120,747	251,495	41,452	8
679,832	31,165	43,176	260,598	124,907	70,766	32,655	116,565	97,272	3,776,552	84,429	1,585,553	110,700	38,798	9
3,976,629	157,970	196,303	1,742,716	818,332	314,607	579,340	167,361	582,681	18,066,479	655,788	5,617,846	108,111	290,927	10
243,683	5,894	27,277	76,317	68,638	17,852	18,041	29,664	26,871	1,116,900	26,612	448,202	31,602	20,681	11
131,203	3,615	14,697	59,266	46,565	7,060	....	....	15,737	552,188	24,404	248,159	7,376	5,099	12
57,032	3,798	2,891	16,367	11,064	6,353	....	16,559	7,208	151,826	6,739	46,158	6,415	624	13
3,172,557	162,667	367,372	1,364,598	1,038,145	230,519	2,931	6,325	175,758	13,909,741	561,994	3,758,140	622,464	52,167	14
1,170,598	45,223	268,828	490,827	320,926	44,753	....	41	48,299	5,201,402	136,570	1,642,802	201,267	34,140	15
9,306,172	348,775	776,227	3,746,593	2,227,219	866,705	1,331,915	8,738	256,165	36,980,094	1,888,496	10,976,574	1,306,230	433,273	16
1,234,938	46,881	34,790	595,722	341,513	88,038	21,695	106,299	26,049	5,955,622	365,357	1,718,517	78,282	6,627	17
3,391,394	177,319	456,372	1,460,120	949,727	240,459	92,117	15,280	232,592	18,504,677	633,743	5,292,930	816,032	170,688	18
3,061,946	111,317	319,380	1,420,525	737,661	199,539	108,289	165,235	170,308	14,047,574	485,394	4,737,502	681,625	173,417	19
1,100,299	40,229	137,429	480,200	331,185	75,208	....	36,048	100,915	4,805,932	150,178	1,912,598	244,698	86,484	20
2,809,217	148,390	345,092	1,358,418	681,755	173,898	28,903	72,761	128,427	19,913,993	359,089	6,507,267	396,729	186,515	21
1,328,692	54,881	75,165	644,460	394,997	126,143	14,916	18,130	121,136	6,293,176	230,691	1,832,562	158,513	38,027	22
441,023	23,190	25,427	174,578	140,382	63,321	3,004	11,121	22,813	2,565,929	74,741	875,984	104,228	30,525	23
808,630	26,345	35,336	219,388	117,443	37,732	368,655	3,731	43,115	3,255,060	177,088	900,350	68,882	25,613	24
362,571	17,797	32,452	173,405	77,782	44,741	3,500	12,894	76,926	2,590,944	70,280	988,916	121,457	15,487	25
1,841,322	43,052	150,481	620,144	438,393	128,221	460,962	69	28,063	6,665,128	195,022	2,249,617	244,077	42,208	26
11,984	873	545	7,253	2,804	509	....	....	340	107,261	579	39,231	900	....	27
263,665	5,363	21,189	77,667	35,868	14,778	108,800	....	18,254	1,151,760	27,097	331,336	44,926	3,834	28
199,020	12,739	14,670	77,913	52,754	14,282	26,662	....	27,905	1,003,224	14,851	432,718	41,686	13,480	29
969,250	50,913	59,468	391,566	193,114	87,146	186,054	989	85,178	5,051,401	254,811	1,346,745	156,788	51,141	30
357,924	16,000	28,018	154,004	80,363	13,124	43,582	22,833	47,102	1,954,762	78,186	755,200	68,534	14,091	31
188,683	5,333	30,166	92,677	38,175	5,614	6,889	9,829	19,437	1,061,763	28,827	395,181	64,136	12,553	32
130,219	3,703	9,450	56,751	14,913	3,106	7,625	34,671	32,363	809,721	10,543	490,669	46,893	11,990	33
59,311	2,411	1,206	32,803	20,777	2,114	....	....	4,540	583,312	18,856	297,109	68,972	4,097	34
288,201	19,364	38,110	83,426	40,220	19,940	....	87,141	29,904	1,933,695	97,848	865,759	10,279	12,845	35
113,448	5,271	8,608	51,421	29,166	3,854	....	15,128	3,772	618,167	30,175	236,340	28,570	330	36
380,750	20,734	57,322	145,929	83,151	12,044	61,570	....	10,340	1,804,124	92,024	492,244	69,733	10,325	37
419,222	10,851	26,154	185,172	70,997	18,718	44,649	62,681	32,986	1,711,764	77,981	622,411	70,272	1,049	38
322,859	7,645	36,389	114,329	71,323	24,139	52,047	16,987	16,007	1,286,392	44,628	523,498	69,074	2,709	39
82,205	1,978	8,458	30,972	17,344	3,637	13,669	6,147	597	370,656	9,845	196,052	24,560	....	40
143,755	4,670	7,047	43,176	28,851	22,324	22,275	15,412	11,668	563,939	14,902	243,933	33,211	2,000	41
397,227	18,897	77,964	164,760	102,635	15,955	13,496	3,520	44,040	2,047,945	67,316	699,371	102,276	16,976	42
92,494	5,908	9,229	43,788	17,868	7,294	3,535	4,872	5,903	569,538	17,101	216,903	33,881	4,884	43
518,423	31,232	27,047	278,774	110,383	34,671	12,600	23,716	55,386	2,706,791	115,019	960,540	82,127	17,592	44
65,655	3,913	214	28,356	11,157	7,900	10,681	3,434	53,715	413,141	4,316	120,769	1,382	4,787	45
318,575	12,904	34,846	125,376	75,045	30,320	11,980	28,104	32,981	1,938,760	47,281	753,168	84,236	8,829	46
247,713	12,753	6,807	98,455	30,983	10,699	2,989	85,027	9,004	1,274,500	27,820	636,951	19,378	24,337	47
47,889	1,595	1,309	8,411	7,722	21,847	7,005	....	1,572	150,151	5,012	74,665	5,704	845	48
905,733	26,577	67,904	341,535	141,441	54,759	120,400	153,117	54,347	3,576,314	114,831	1,370,862	73,110	80,233	49
394,687	14,900	6,250	209,359	92,563	17,781	39,590	14,244	47,977	1,998,388	83,835	540,771	161	15,180	50
2,676,209	116,493	122,149	1,191,822	584,328	242,067	419,350	....	480,357	12,491,777	457,122	3,706,213	34,840	195,514	51

TABLE 163.—OPERATING EXPENSES, BY DETAILED

	DIVISION AND STATE.	CONDUCTING TRANSPORTATION—continued.							
		Power—Continued.					Operation of cars.		
		Fuel for power.	Other power supplies and expenses.	Power purchased.	Power exchanged—balance.	Other operations.[1]	Total.	Conductors, motormen, and trainmen.	Miscellaneous transportation expenses.
1	UNITED STATES	$20,145,466	$2,021,521	$24,546,530	$150,117	$5,464,581	$122,077,311	$98,185,596	$23,891,715
	GEOGRAPHIC DIVISIONS:								
2	New England	3,194,864	319,326	1,424,171	1,348	221,917	14,032,277	10,933,511	3,098,766
3	Middle Atlantic	6,603,815	713,608	7,795,789	6,112	57,565	40,564,776	32,545,206	8,019,570
4	East North Central	5,223,268	444,541	6,651,143	14,802	1,431,398	30,460,598	23,991,958	6,468,640
5	West North Central	2,099,604	150,432	1,809,505		260,077	9,346,292	7,779,376	1,566,916
6	South Atlantic	1,064,457	111,151	1,375,750		1,284,426	7,106,572	5,961,818	1,144,754
7	East South Central	738,135	114,035	376,236		358,077	3,114,253	2,638,470	475,783
8	West South Central	855,008	62,270	640,589	3,651	266,282	3,553,128	3,142,144	410,984
9	Mountain	279,355	29,920	557,620		569,160	2,106,570	1,802,316	304,254
10	Pacific	86,960	76,238	3,915,727	124,204	1,015,679	11,792,845	9,390,797	2,402,048
	NEW ENGLAND:								
11	Maine	78,393	6,326	167,442		143,758	642,086	497,501	144,585
12	New Hampshire	8,833	2,415	224,436			279,625	231,758	47,867
13	Vermont		5,313	29,871		3,935	98,929	83,573	15,356
14	Massachusetts	2,263,919	222,115	567,163	1,348	28,964	9,589,607	7,349,707	2,239,900
15	Rhode Island and Connecticut	843,719	83,157	435,259		45,260	3,422,030	2,770,972	651,058
	MIDDLE ATLANTIC:								
16	New York	4,243,890	496,285	4,446,174	4,477	46,245	24,115,024	18,520,323	5,594,701
17	New Jersey	217,167	16,956	1,399,485			3,871,748	3,269,139	602,609
18	Pennsylvania	2,142,758	200,367	1,950,130	1,635	11,320	12,578,004	10,755,744	1,822,260
	EAST NORTH CENTRAL:								
19	Ohio	2,006,935	171,379	941,839	6,932	755,375	8,824,678	7,095,072	1,729,606
20	Indiana	705,691	48,433	607,537		219,755	2,743,156	1,939,438	803,718
21	Illinois	1,402,328	145,134	4,029,543		347,018	13,047,637	10,397,616	2,650,021
22	Michigan	602,105	31,325	922,443	2,706	77,443	4,229,923	3,266,198	963,725
23	Wisconsin	506,209	48,270	149,781	5,164	31,807	1,615,204	1,293,634	321,570
	WEST NORTH CENTRAL:								
24	Minnesota	397,637	13,304	348,025		46,889	2,177,622	1,754,145	423,477
25	Iowa	385,755	22,182	273,336		170,699	1,531,748	1,220,216	311,532
26	Missouri	967,969	82,388	912,975			4,220,489	3,614,190	606,299
27	North Dakota and South Dakota	3,120	1,528	33,683			67,451	59,814	7,637
28	Nebraska	243,491	19,328	19,456		301	793,327	678,063	115,264
29	Kansas	101,632	11,702	222,030		42,188	555,655	452,948	102,707
	SOUTH ATLANTIC:								
30	Delaware, Maryland, and District of Columbia	476,257	36,883	620,521		5,155	3,449,845	2,904,973	544,872
31	Virginia	175,625	19,589	62,552		414,809	1,121,376	887,437	233,939
32	West Virginia	155,551	17,899	108,685		36,357	637,755	553,616	84,139
33	North Carolina	86,975	7,892	145,716		191,203	308,509	259,775	48,734
34	South Carolina	95,518	17,650	110,872			267,347	218,559	48,788
35	Georgia	8,483	5,579	317,385		511,188	970,088	832,868	137,220
36	Florida	66,048	5,659	10,019		125,714	351,652	304,590	47,062
	EAST SOUTH CENTRAL:								
37	Kentucky	233,980	21,946	156,260			1,219,856	1,041,138	178,718
38	Tennessee	233,971	17,527	109,665		189,927	1,011,372	877,979	133,393
39	Alabama	191,942	58,976	66,041		134,756	718,266	574,949	143,317
40	Mississippi	78,242	15,586	44,270		33,394	164,759	144,404	20,355
	WEST SOUTH CENTRAL:								
41	Arkansas	102,003	16,068	25,233		65,418	305,104	261,626	43,478
42	Louisiana	338,524	22,277	189,181		30,137	1,281,258	1,228,961	52,297
43	Oklahoma	88,435	5,190	70,820		13,693	335,534	278,206	57,328
44	Texas	326,046	18,735	355,355	3,651	157,034	1,631,232	1,373,351	257,881
	MOUNTAIN:								
45	Montana		4,426	92,263		17,911	288,056	265,415	22,641
46	Colorado	252,422	18,554	157,313		231,814	1,138,311	963,380	174,931
47	Idaho, Wyoming, Utah, and Nevada	17,336	3,091	253,374		319,435	609,729	509,006	100,723
48	New Mexico and Arizona	9,597	3,849	54,670			70,474	64,515	5,959
	PACIFIC:								
49	Washington	4,344	49,617	429,574		733,984	2,090,621	1,730,067	360,554
50	Oregon	5,350	514	118,693	89,178	281,695	1,373,782	1,072,327	301,455
51	California	77,266	26,107	3,337,460	35,026		8,328,442	6,588,403	1,740,039

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[1] Expenses of light and power departments not distributed among prior accounts.

ACCOUNTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1912—Continued.

GENERAL AND MISCELLANEOUS.									TOTAL OPERATING EXPENSES OF LIGHT AND POWER DEPARTMENTS INCLUDED IN TOTAL OPERATING EXPENSES OF ELECTRIC RAILWAYS.					
			Undistributed accounts.											
Total.	General expenses.	Other operations.[1]	Injuries and damages.	Insurance.	Stationery and printing.	Store and stable expenses.	Rent of tracks and terminals.	Rent of equipment.	Total.	Way and structures.	Equipment.	Power.	General and miscellaneous.	
$54,172,804	$19,133,239	$3,160,839	$20,707,960	$3,151,576	$1,105,422	$2,040,409	$3,676,337	$1,197,022	$14,195,822	$2,101,103	$1,339,176	$6,885,995	$3,869,548	1
5,823,148	2,072,266	119,622	2,595,922	409,429	127,083	256,415	137,723	104,688	479,332	72,059	53,958	226,473	126,842	2
17,572,048	5,658,605	31,788	7,732,052	1,002,157	270,098	937,294	1,470,705	469,349	761,829	187,781	169,940	265,111	138,997	3
12,053,613	4,424,014	666,197	4,052,475	736,713	269,554	354,461	1,321,780	228,419	3,397,906	464,812	360,988	1,748,484	823,622	4
4,517,463	1,589,431	357,801	1,808,499	314,535	80,665	148,082	154,969	63,481	980,455	65,281	39,729	453,529	421,916	5
4,204,720	1,601,600	770,638	1,114,961	242,712	96,898	109,629	153,541	114,741	3,480,259	606,555	235,616	1,667,895	970,193	6
2,121,294	626,905	194,445	990,424	80,600	33,480	17,582	174,342	3,516	949,745	100,033	109,357	484,381	255,974	7
2,054,817	767,018	177,824	746,716	138,226	59,996	48,862	111,863	4,312	813,834	98,843	78,972	396,552	239,467	8
1,017,015	500,196	200,057	162,926	47,706	23,670	22,591	33,559	26,310	1,159,888	189,164	119,903	612,582	238,239	9
4,808,686	1,893,204	642,467	1,503,985	179,498	143,978	145,493	117,855	182,206	2,172,574	316,575	170,713	1,030,988	654,298	10
330,429	144,155	72,120	59,570	36,561	6,272	8,098	640	3,013	305,754	47,067	31,033	148,314	79,340	11
129,166	56,397	....	47,032	12,219	2,605	3,605	4,022	3,286	....	....	....	....	....	12
68,061	37,729	15,441	5,230	4,960	1,237	1,505	1,141	818	43,962	8,027	16,559	3,935	15,441	13
4,015,724	1,490,289	12,824	1,783,315	248,153	95,546	188,471	121,037	76,089	58,627	10,514	6,325	28,964	12,824	14
1,279,768	343,696	19,237	700,775	107,536	21,423	54,736	10,883	21,482	70,989	6,451	41	45,260	19,237	15
10,757,489	3,370,551	25,493	4,562,415	597,467	144,338	640,729	1,017,626	398,870	510,797	107,537	44,916	235,117	123,227	16
1,602,954	586,554	....	711,557	102,386	29,278	63,596	107,355	2,228	152,887	45,465	106,362	796	264	17
5,211,605	1,701,500	6,295	2,458,080	302,304	96,482	232,969	345,724	68,251	98,145	34,779	18,662	29,198	15,506	18
3,608,000	1,511,078	383,458	983,352	215,191	80,673	115,008	207,735	111,505	1,867,599	300,441	196,957	904,625	465,576	19
1,633,557	595,862	76,864	410,687	99,675	49,396	36,495	342,330	22,248	375,854	29,586	36,648	225,155	84,465	20
4,464,693	1,415,181	132,499	1,761,874	294,503	70,742	109,540	631,798	48,556	658,715	88,431	72,761	365,024	132,499	21
1,668,145	642,210	46,217	632,643	78,789	47,936	66,679	115,875	37,796	266,227	28,187	23,043	156,089	58,908	22
679,218	259,683	27,159	263,919	48,555	20,807	26,739	24,042	8,314	229,511	18,167	31,579	97,591	82,174	23
924,462	419,040	24,992	332,107	57,739	18,783	39,301	32,500	....	91,268	15,656	3,731	46,889	24,992	24
1,041,428	332,668	305,464	156,907	55,281	24,605	25,433	85,381	55,689	601,501	26,275	17,850	246,244	311,132	25
1,935,956	539,101	....	1,115,693	165,374	24,301	71,582	12,718	7,187	90,338	10,375	7,989	48,360	23,614	26
34,082	22,012	....	7,383	3,337	1,340	10	....	....	....	....	....	....	....	27
290,606	136,711	....	114,984	10,025	5,138	7,042	16,706	....	49,322	....	....	32,604	16,718	28
290,929	139,899	27,345	81,425	22,779	6,498	4,714	7,664	605	148,026	12,975	10,159	79,432	45,460	29
1,390,554	589,427	2,668	514,910	97,141	39,297	52,668	27,640	66,803	188,791	21,818	20,989	100,777	45,207	30
828,764	317,420	175,159	175,512	44,000	21,755	26,388	30,587	37,943	943,966	217,341	31,127	476,384	219,114	31
336,242	161,115	8,059	63,357	25,221	6,485	6,720	61,052	4,233	166,098	19,634	18,312	102,558	25,594	32
306,810	109,511	124,718	36,649	19,333	4,331	1,904	6,581	3,783	477,025	56,170	42,553	232,310	145,992	33
179,416	95,634	....	61,927	13,446	3,827	3,609	....	973	230,719	39,454	17,132	110,596	63,537	34
872,518	215,068	366,646	200,646	32,366	15,576	14,535	27,681	....	1,188,230	200,938	90,375	519,556	377,361	35
290,416	113,425	93,388	61,960	11,205	5,627	3,805	....	1,006	285,430	51,200	15,128	125,714	93,388	36
738,675	174,287	....	362,683	31,391	7,053	5,628	157,633	....	....	....	....	....	....	37
805,823	230,945	116,568	394,765	24,941	14,909	5,710	16,269	1,716	501,259	23,936	74,347	254,922	148,054	38
467,960	175,360	57,441	202,910	18,379	9,230	2,400	440	1,800	248,453	39,269	16,987	134,756	57,441	39
108,836	46,313	20,436	30,066	5,889	2,288	3,844	....	....	200,033	36,828	18,023	94,703	50,479	40
197,404	78,773	42,342	51,190	14,383	4,964	4,226	1,526	....	258,353	28,364	36,909	125,557	67,523	41
323,429	83,493	63,720	54,761	79,557	26,633	10,573	4,692	....	157,146	15,391	9,845	57,980	73,930	42
196,589	122,598	9,113	46,143	7,996	3,980	5,170	715	874	69,154	10,241	5,570	36,270	17,073	43
1,337,395	482,154	62,649	594,622	36,290	24,419	28,893	104,930	3,438	329,181	44,847	26,648	176,745	80,941	44
158,482	111,993	9,269	29,412	6,538	999	271	....	....	94,768	6,315	3,434	43,802	41,217	45
562,536	250,253	112,316	83,607	31,149	12,042	15,691	33,219	24,259	463,656	89,623	28,104	233,525	112,404	46
262,039	115,301	78,472	42,204	8,430	9,668	5,813	100	2,051	569,065	86,131	85,027	319,435	78,472	47
33,958	22,649	....	7,703	1,589	961	816	240	....	32,399	7,095	3,338	15,820	6,146	48
1,496,264	472,259	376,949	424,181	61,498	35,919	25,836	28,419	71,203	1,557,279	262,737	156,469	749,293	388,780	49
866,670	244,097	265,518	179,622	30,651	23,166	15,108	55,385	53,123	615,295	53,838	14,244	281,695	265,518	50
2,445,752	1,176,848	....	900,182	87,349	84,893	104,549	34,051	57,880	....	....	....	....	....	51

TABLE 164.—CONDENSED BALANCE SHEET OF OPERATING AND LESSOR COMPANIES COMBINED, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902.

DIVISION AND STATE.	Census.	Number of companies.	ASSETS.				Total—Assets or liabilities.	LIABILITIES.				Net surplus.[1]
			Cost of construction, equipment, and real estate.	Other investments.	Current and other assets.	Profit and loss deficit for companies showing a deficit.		Capital stock.	Funded debt.	Unfunded debt, reserves, and current and other liabilities.	Profit and loss surplus for companies showing a surplus.	
UNITED STATES	1912	1,260	$4,596,563,292	$465,250,414	$348,731,487	$38,149,444	$5,448,694,637	$2,379,346,313	$2,329,221,828	$606,690,400	$133,436,096	$95,286,652
	1907	[2]1,230	3,637,668,708	374,664,197	251,528,687	36,178,933	4,300,040,525	2,031,986,366	1,672,959,930	488,471,004	106,623,225	70,444,292
	1902	[3]967	2,167,634,077	152,513,997	213,699,184	11,285,047	2,545,132,305	1,266,883,289	974,112,422	252,145,435	51,991,159	40,706,112
GEOGRAPHIC DIVISIONS:												
New England	1912	119	354,605,174	13,591,713	23,549,590	1,814,262	393,560,739	204,443,600	129,639,840	48,492,176	10,985,123	9,170,861
	1907	145	286,023,884	4,985,719	18,911,758	1,570,677	311,492,038	138,158,388	130,606,958	33,647,659	9,079,033	7,508,356
	1902	166	194,281,999	2,893,501	13,576,176	1,124,962	211,876,638	110,186,597	70,264,242	27,386,093	4,039,706	2,914,744
Middle Atlantic	1912	436	1,471,795,717	201,251,361	127,930,909	20,736,273	1,821,714,260	711,998,377	801,582,533	263,183,933	44,949,417	24,213,144
	1907	450	1,266,196,650	113,030,336	133,576,459	20,624,376	1,533,427,821	708,879,726	557,410,106	226,811,383	40,326,606	19,702,230
	1902	343	894,650,238	69,201,142	120,260,275	5,190,926	1,089,302,581	528,971,736	385,983,823	146,105,604	28,241,418	23,050,492
East North Central	1912	253	1,099,283,481	98,896,346	56,645,231	7,389,291	1,262,214,349	534,303,711	589,361,398	105,915,709	32,633,531	25,244,240
	1907	263	970,924,964	129,874,562	32,500,080	8,965,594	1,142,265,200	589,696,045	436,565,900	91,716,445	24,286,810	15,321,216
	1902	189	518,927,728	44,172,172	40,865,503	3,418,919	607,384,322	328,198,994	226,033,177	46,119,544	7,032,607	3,613,688
West North Central	1912	90	336,808,451	13,518,452	14,077,887	390,597	364,795,387	159,247,520	155,092,155	40,228,343	10,227,369	9,836,772
	1907	77	280,458,765	5,804,107	6,459,986	273,787	292,996,645	126,192,796	130,583,800	29,812,516	6,407,533	6,133,746
	1902	59	186,626,205	24,426,974	9,466,756	660,265	221,180,200	110,229,425	94,981,149	11,229,359	4,740,267	4,080,002
South Atlantic	1912	123	375,467,897	40,417,302	31,574,545	1,673,443	449,133,187	196,567,505	205,449,168	34,901,604	12,214,910	10,541,467
	1907	110	242,357,969	32,955,988	12,718,757	1,273,932	289,306,646	108,341,030	151,682,049	21,600,176	7,683,391	6,409,459
	1902	77	162,507,589	6,063,844	6,560,203	706,947	175,838,583	66,887,171	100,219,908	6,972,848	1,758,656	1,051,709
East South Central	1912	46	124,119,747	10,299,276	7,834,970	397,074	142,651,067	57,169,564	71,296,580	10,394,792	3,790,131	3,393,057
	1907	40	107,392,029	4,623,624	3,625,222	250,590	115,891,465	50,465,280	53,758,167	9,383,814	2,284,204	2,033,614
	1902	34	55,049,569	1,686,255	3,503,849	38,466	60,278,139	27,814,700	28,213,200	2,786,504	1,463,735	1,425,269
West South Central	1912	83	136,295,611	24,184,728	12,792,829	855,978	174,129,146	86,542,205	65,691,669	17,099,641	4,795,631	3,939,653
	1907	51	95,693,842	30,838,166	5,738,862	290,224	132,561,094	69,202,250	45,827,950	12,978,340	4,552,548	4,262,324
	1902	32	32,245,293	180,486	10,597,959	26,759	43,050,497	22,521,100	15,020,900	4,475,684	1,032,813	1,006,054
Mountain	1912	42	90,534,736	18,588,315	4,935,757	633,601	114,692,409	48,204,727	46,014,459	14,407,043	6,066,180	5,432,579
	1907	29	50,578,599	14,524,397	3,168,522	250,029	68,521,547	30,432,451	29,699,600	5,341,792	3,047,704	2,797,675
	1902	18	23,911,279	1,892,662	1,116,920	90,315	27,011,176	12,626,517	12,381,710	1,341,791	661,158	570,843
Pacific	1912	68	607,652,478	44,502,921	69,389,769	4,258,925	725,804,093	380,869,104	265,094,026	72,067,159	7,773,804	3,514,879
	1907	65	338,042,006	38,027,298	34,829,041	2,679,724	413,578,069	210,618,400	136,825,400	57,178,873	8,955,396	6,275,672
	1902	49	99,434,177	1,996,961	7,751,543	27,488	109,210,169	59,447,049	41,014,313	5,728,008	3,020,799	2,993,311
NEW ENGLAND:												
Maine	1912	17	28,479,941	7,240,814	1,558,524	53,607	37,332,886	16,041,825	19,102,382	1,077,798	1,110,881	1,057,274
	1907	17	21,413,212	1,000,662	701,904	69,631	23,185,409	10,944,713	11,039,000	896,027	305,669	236,038
	1902	20	11,176,556	559,960	421,341	318,370	12,476,227	5,053,055	6,155,000	888,265	379,907	61,537
New Hampshire	1912	13	7,011,443	5,241	274,902	287,779	7,579,365	4,163,400	2,322,000	971,873	122,092	*165,687*
	1907	18	7,848,816	....	138,221	58,164	8,045,201	4,518,700	2,589,000	673,893	263,608	205,444
	1902	13	4,118,457	....	313,007	3,730	4,435,194	2,333,200	1,556,000	453,885	92,109	88,379
Vermont	1912	9	6,073,617	384,399	360,984	58,718	6,877,718	2,848,100	2,813,558	370,770	845,290	786,572
	1907	10	5,382,047	700,000	83,299	396,520	6,561,866	3,370,000	2,548,667	350,020	293,179	*103,341*
	1902	9	2,850,460	....	330,013	22,866	3,203,339	1,835,100	931,600	401,785	34,854	11,988
Massachusetts	1912	60	194,677,690	190,501	16,119,438	1,222,533	212,210,162	93,791,575	80,728,700	32,811,427	4,878,460	3,655,927
	1907	81	149,681,514	1,116,829	12,583,872	955,785	164,338,000	74,397,675	60,279,000	25,785,601	3,875,724	2,919,939
	1902	92	109,782,044	212,011	11,227,224	406,371	121,627,650	59,378,602	37,966,942	21,897,899	2,384,207	1,977,836
Rhode Island and Connecticut.	1912	20	118,362,483	5,770,758	5,235,742	191,625	129,560,608	87,598,700	24,673,200	13,260,308	4,028,400	3,836,775
	1907	19	101,698,295	2,168,228	5,404,462	90,577	109,361,562	44,927,300	54,151,291	5,942,118	4,340,853	4,250,276
	1902	32	66,354,482	2,121,530	1,284,591	373,625	70,134,228	41,586,640	23,654,700	3,744,259	1,148,629	775,004
MIDDLE ATLANTIC:												
New York	1912	134	913,345,909	59,320,861	102,995,073	8,465,710	1,084,127,553	389,019,080	481,571,770	179,354,982	34,181,721	25,716,011
	1907	147	709,343,843	70,032,687	79,686,561	15,403,659	874,466,750	377,957,549	336,447,138	135,450,961	24,611,102	9,207,443
	1902	119	521,942,957	36,751,267	80,932,371	3,388,249	643,014,844	276,209,172	252,929,373	96,837,093	17,039,206	13,650,957
New Jersey	1912	43	176,912,642	3,425,461	4,250,179	1,405,771	185,994,053	76,757,176	94,932,000	11,647,540	2,657,337	1,251,566
	1907	41	161,901,839	4,336,865	2,354,131	1,518,654	170,111,489	71,811,380	86,260,500	9,947,942	2,091,667	573,013
	1902	29	126,589,270	880,908	3,604,951	954,154	132,029,283	69,333,440	57,490,750	4,385,087	820,006	*134,148*
Pennsylvania	1912	259	381,537,166	138,505,039	20,685,657	10,864,792	551,592,654	246,222,121	225,078,763	72,181,411	8,110,359	*2,754,433*
	1907	262	394,950,968	38,660,784	51,535,767	3,702,063	488,849,582	259,110,797	134,702,468	81,412,480	13,623,837	9,921,774
	1902	195	246,118,011	31,568,967	35,722,953	848,523	314,258,454	183,429,124	75,563,700	44,883,424	10,382,206	9,533,683
EAST NORTH CENTRAL:												
Ohio	1912	88	323,609,762	58,157,628	14,389,117	2,451,774	398,608,281	211,767,450	138,806,040	38,563,945	9,470,846	7,019,072
	1907	90	321,678,074	46,671,014	10,496,568	1,896,288	380,741,944	226,845,875	116,289,000	30,294,146	7,312,923	5,416,635
	1902	66	169,058,687	1,147,336	10,982,197	225,868	181,414,088	108,638,650	60,942,000	9,416,549	2,416,889	2,191,021
Indiana	1912	45	193,842,423	11,347,204	6,047,029	341,211	211,577,867	101,946,135	89,385,787	15,923,124	4,322,821	3,981,610
	1907	43	166,387,274	7,646,403	3,394,437	742,436	178,170,550	94,223,970	72,063,350	8,604,850	3,278,380	2,535,944
	1902	26	39,420,184	10,435	3,890,682	133,194	43,454,495	16,635,028	21,550,760	4,866,887	401,820	268,626
Illinois	1912	72	406,577,828	9,886,219	25,787,715	4,390,982	446,642,744	150,734,120	256,620,427	31,830,756	7,457,441	3,066,459
	1907	86	346,693,323	49,073,436	13,154,827	5,863,939	414,785,525	200,154,400	167,379,400	38,500,298	8,751,427	2,887,488
	1902	56	225,507,387	40,237,103	16,275,609	2,933,026	284,953,125	158,713,616	97,885,267	26,247,246	2,106,996	*826,030*
Michigan	1912	23	109,694,970	5,826,260	4,852,469	138,822	120,512,521	41,995,506	60,111,724	10,735,526	7,669,765	7,530,943
	1907	24	88,391,281	6,539,663	2,577,316	231,475	97,789,735	38,607,400	48,625,900	7,561,102	2,995,333	2,713,858
	1902	24	55,582,232	2,068,542	8,452,629	124,483	66,227,886	29,033,100	32,596,800	3,624,018	973,968	849,485
Wisconsin	1912	25	65,558,498	13,679,035	5,568,901	66,502	84,872,936	27,860,500	44,437,420	8,862,358	3,712,658	3,646,156
	1907	20	47,775,012	19,944,046	2,876,932	181,456	70,777,446	29,864,400	32,208,250	6,756,049	1,948,747	1,767,291
	1902	17	29,359,238	708,756	1,264,386	2,348	31,334,728	15,178,600	13,058,350	1,964,844	1,132,934	1,130,586

[1] Italic figures indicate deficits.
[2] Exclusive of 6 companies which failed to furnish this information.
[3] Exclusive of 20 companies which failed to furnish this information.

Table 164.—CONDENSED BALANCE SHEET OF OPERATING AND LESSOR COMPANIES COMBINED, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902—Continued.

DIVISION AND STATE.	Census.	Number of companies.	ASSETS.				Total—Assets or liabilities.	LIABILITIES.				
			Cost of construction, equipment, and real estate.	Other investments.	Current and other assets.	Profit and loss deficit for companies showing a deficit.		Capital stock.	Funded debt.	Unfunded debt, reserves, and current and other liabilities.	Profit and loss surplus for companies showing a surplus.	Net surplus.[1]
WEST NORTH CENTRAL:												
Minnesota	1912	9	$60,781,293	$718,354	$1,852,567	$93,271	$63,445,485	$32,319,200	$23,580,000	$5,780,114	$1,766,171	$1,672,900
	1907	5	47,567,987	1,119,824	1,546,357	....	50,234,168	23,905,000	20,912,500	4,492,385	924,283	924,283
	1902	5	39,273,860	....	731,325	11,100	40,016,285	23,280,000	13,226,000	720,675	2,789,610	2,778,510
Iowa	1912	26	60,135,647	1,396,387	2,771,526	37,770	64,341,330	28,827,219	24,708,900	7,801,338	3,003,873	2,966,103
	1907	26	35,319,366	1,460,557	1,390,591	142,233	38,312,747	20,693,046	12,804,500	2,797,654	2,017,547	1,875,314
	1902	22	18,035,123	47,704	1,764,935	129,898	19,977,660	10,541,200	6,770,333	1,476,591	1,189,536	1,059,638
Missouri	1912	19	158,721,248	2,041,345	6,444,829	159,873	167,367,295	59,298,850	79,947,200	23,949,862	4,171,383	4,011,510
	1907	14	156,852,689	2,511,524	2,858,451	49,764	162,272,428	58,819,400	80,836,000	20,384,868	2,232,160	2,182,396
	1902	17	117,628,659	24,379,270	6,542,348	510,243	149,060,520	68,234,100	71,474,816	8,783,327	568,277	58,034
North Dakota and South Dakota.[2]	1912	5	1,517,890	....	363,611	142	1,881,643	1,060,350	514,555	240,947	65,791	65,649
	1907	5	831,358	....	13,358	....	844,716	384,980	300,000	120,916	38,820	38,820
Nebraska	1912	10	28,670,146	7,851,866	749,944	14,157	37,286,113	21,584,276	13,639,000	1,906,844	155,993	141,836
	1907	10	25,050,412	161,079	430,195	....	25,641,686	13,864,585	9,540,000	1,622,190	614,911	614,911
	1902	4	8,599,242	....	205,999	1,845	8,807,086	6,012,125	2,395,000	207,641	192,320	190,475
Kansas	1912	21	26,982,227	1,510,500	1,895,410	85,384	30,473,521	16,157,625	12,702,500	549,238	1,064,158	978,774
	1907	17	14,836,953	551,123	221,034	81,790	15,690,900	8,525,785	6,190,800	394,503	579,812	498,022
	1902	11	3,089,321	....	222,149	7,179	3,318,649	2,162,000	1,115,000	41,125	524	*6,655*
SOUTH ATLANTIC:												
Delaware, Maryland, and District of Columbia.	1912	32	147,147,538	14,568,430	13,218,868	642,035	175,576,871	63,551,800	97,156,468	11,271,499	3,597,104	2,955,069
	1907	28	122,253,326	14,680,971	3,869,632	1,025,456	141,829,385	51,371,045	82,389,709	6,917,430	1,151,201	125,745
	1902	23	101,253,370	30,000	2,169,975	606,553	104,059,898	35,844,546	64,063,194	3,631,459	520,699	*85,854*
Virginia	1912	20	66,483,222	7,916,085	7,143,965	791,705	82,334,977	34,205,600	38,125,100	8,379,445	1,624,832	833,127
	1907	23	40,306,693	9,216,670	3,588,090	84,281	53,195,734	14,926,650	30,667,490	5,439,231	2,162,363	2,078,082
	1902	16	15,414,124	3,284,535	1,017,041	57,597	19,773,297	7,277,000	11,019,314	1,267,342	209,641	152,044
West Virginia	1912	24	34,958,364	4,567,151	2,697,258	181,689	42,404,462	19,621,100	18,304,900	2,914,661	1,563,801	1,382,112
	1907	18	22,087,542	2,486,732	926,905	85,843	25,587,022	10,704,075	10,406,500	3,288,847	1,187,600	1,101,757
	1902	8	9,039,281	244,819	718,802	2,450	10,005,352	4,273,600	5,308,400	287,580	135,772	133,322
North Carolina	1912	15	18,819,628	6,948,164	2,397,901	19,674	28,185,367	15,749,300	8,174,000	3,464,232	797,835	778,161
	1907	12	7,698,294	1,585,259	1,192,248	25,114	10,500,915	4,409,800	3,887,750	1,579,275	624,090	598,976
	1902	7	2,408,661	639,690	1,348,522	34,103	4,430,976	1,995,625	1,880,500	537,562	17,289	*16,814*
South Carolina	1912	7	12,708,219	1,079,101	2,008,902	4,333	15,800,555	8,972,905	4,076,400	2,471,648	279,602	275,269
	1907	7	9,154,985	1,296,500	340,797	1,981	10,794,263	3,984,200	4,766,000	1,678,781	365,282	363,301
	1902	7	4,523,752	1,730,000	429,529	6,244	6,689,525	2,589,400	3,336,000	688,659	75,466	69,222
Georgia	1912	15	83,962,495	4,594,871	3,193,231	900	91,751,497	48,681,200	34,248,800	5,085,676	3,735,821	3,734,921
	1907	12	32,381,692	3,577,856	2,326,444	15,642	38,301,634	18,110,400	16,789,600	1,793,834	1,607,800	1,592,158
	1902	10	26,157,673	134,800	764,425	....	27,056,898	12,957,600	13,081,500	346,232	671,566	671,566
Florida	1912	10	11,388,431	743,500	914,420	33,107	13,079,458	5,785,600	5,363,500	1,314,443	615,915	582,808
	1907	10	8,475,437	112,000	474,641	35,615	9,097,693	4,834,860	2,775,000	902,778	585,055	549,440
	1902	6	3,710,728	....	111,909	....	3,822,637	1,949,400	1,531,000	214,014	128,223	128,223
EAST SOUTH CENTRAL:												
Kentucky	1912	10	36,301,326	5,280,966	1,669,184	125,091	43,376,567	18,865,030	20,397,120	3,371,938	742,479	617,388
	1907	13	34,693,140	384,262	923,044	44,227	36,044,673	16,047,400	15,726,000	3,233,557	1,037,716	993,489
	1902	12	22,850,276	40,928	2,326,661	21,921	25,239,786	11,330,900	12,204,300	823,596	880,990	859,069
Tennessee	1912	12	49,355,376	1,212,638	3,420,102	3,177	53,991,293	20,701,000	28,878,000	2,877,846	1,534,447	1,531,270
	1907	9	38,731,679	270,000	1,161,147	641	40,163,467	17,499,100	19,348,000	2,697,966	618,401	617,760
	1902	8	16,931,576	582,015	627,594	1,122	18,142,307	8,160,400	8,686,400	1,029,231	266,276	265,154
Alabama	1912	12	29,239,743	3,236,923	2,021,394	53,942	34,552,002	12,997,000	17,002,500	3,218,637	1,333,865	1,279,923
	1907	10	27,189,353	2,698,455	938,705	187,604	31,014,117	12,980,900	15,181,667	2,370,628	480,922	293,318
	1902	9	13,999,633	949,116	489,540	13,638	15,451,927	7,696,900	6,678,500	782,767	293,760	280,122
Mississippi	1912	12	9,223,302	568,749	724,290	214,864	10,731,205	4,606,534	5,018,960	926,371	179,340	*35,524*
	1907	8	6,777,857	1,270,907	602,326	18,118	8,669,208	3,937,880	3,502,500	1,081,663	147,165	129,047
	1902	5	1,268,084	114,196	60,054	1,785	1,444,119	626,500	644,000	150,910	22,709	20,924
WEST SOUTH CENTRAL:												
Arkansas	1912	10	12,985,385	57,545	1,427,916	....	14,470,846	6,113,120	6,552,736	983,840	821,150	821,150
	1907	8	9,042,616	1,352,780	341,232	24,400	10,761,028	4,845,600	4,453,000	944,487	517,941	493,541
	1902	7	2,207,346	40,486	253,498	....	2,501,330	885,300	1,058,000	455,040	102,990	102,990
Louisiana	1912	15	57,175,403	21,537,612	6,585,444	18,655	85,317,114	45,453,314	31,922,750	5,697,321	2,243,729	2,225,074
	1907	12	52,216,789	28,607,234	3,762,506	36,520	84,623,049	46,839,700	29,145,000	6,369,083	2,269,266	2,232,746
	1902	8	14,282,507	....	9,775,621	25,959	24,084,087	12,484,900	10,010,000	954,207	634,980	609,021
Oklahoma	1912	18	17,456,621	714,162	1,769,559	210,970	20,151,312	10,844,050	7,151,000	1,932,727	223,535	12,565
	1907	8	6,034,862	222,918	415,231	42,738	6,715,749	4,145,800	2,029,000	416,671	124,278	81,540
Texas	1912	40	48,678,202	1,875,409	3,009,910	626,353	54,189,874	24,131,721	20,065,183	8,485,753	1,507,217	880,864
	1907	23	28,399,575	655,234	1,219,893	186,566	30,461,268	13,371,150	10,200,950	5,248,105	1,641,063	1,454,497
	1902	17	15,755,440	140,000	568,840	800	16,465,080	9,150,900	3,952,900	3,066,437	294,843	294,043

[1] Italic figures indicate deficits.

[2] The 1 company in South Dakota in 1902 failed to furnish this information.

TABLE 164.—CONDENSED BALANCE SHEET OF OPERATING AND LESSOR COMPANIES COMBINED, BY GEOGRAPHIC DIVISIONS AND STATES: 1912, 1907, AND 1902—Continued.

DIVISION AND STATE.	Census.	Number of companies.	ASSETS.				Total—Assets or liabilities.	LIABILITIES.				Net surplus.[1]
			Cost of construction, equipment, and real estate.	Other investments.	Current and other assets.	Profit and loss deficit for companies showing a deficit.		Capital stock.	Funded debt.	Unfunded debt, reserves, and current and other liabilities.	Profit and loss surplus for companies showing a surplus.	
MOUNTAIN:												
Montana	1912	6	$5,957,245	$1,014,356	$337,111	$5,637	$7,314,349	$3,632,532	$2,514,220	$544,871	$622,726	$617,089
	1907	5	3,191,227	1,582,097	174,745	1,639	4,949,708	2,781,275	1,550,000	138,988	479,445	477,806
	1902	5	3,228,532	....	453,999	65,565	3,748,096	2,045,613	1,275,000	260,290	167,193	101,628
Colorado	1912	17	45,575,992	15,610,613	2,415,920	333,174	63,935,699	24,903,550	31,280,130	4,911,014	2,841,005	2,507,831
	1907	11	28,039,230	11,841,272	1,380,009	38,996	41,299,507	17,998,500	19,450,000	2,125,432	1,725,575	1,686,579
	1902	7	16,174,735	210,062	425,882	9,967	16,820,646	7,362,804	8,295,560	797,222	365,060	355,093
All other Mountain states	1912	19	39,001,499	1,963,346	2,182,726	294,790	43,442,361	19,668,645	12,220,109	8,951,158	2,602,449	2,307,659
Idaho, Wyoming, Nevada, and Utah	1912	13	34,049,694	1,625,614	1,355,075	173,850	37,204,233	15,478,945	10,614,309	8,569,137	2,541,842	2,367,992
New Mexico and Arizona	1912	6	4,951,805	337,732	827,651	120,940	6,238,128	4,189,700	1,605,800	382,021	60,607	*60,333*
All other Mountain states.[2]	1907	13	19,348,142	1,101,028	1,613,768	209,394	22,272,332	9,652,676	8,699,600	3,077,372	842,684	633,290
	1902	6	4,508,012	1,682,600	237,039	14,783	6,442,434	3,218,100	2,811,150	284,279	128,905	114,122
PACIFIC:												
Washington	1912	20	136,195,547	10,176,670	13,377,442	577,813	160,327,472	79,319,508	56,926,500	21,227,988	2,853,476	2,275,663
	1907	15	64,863,788	6,445,689	6,287,263	514,195	78,110,935	40,454,900	23,414,000	10,909,697	3,332,338	2,818,143
	1902	8	18,574,439	191,793	1,277,594	....	20,043,826	10,636,400	7,747,813	1,104,228	555,385	555,385
Oregon	1912	6	76,935,219	2,821,462	4,001,809	538,408	84,296,898	25,226,800	43,209,776	14,216,321	1,644,001	1,105,593
	1907	8	21,485,428	17,943,670	2,437,757	....	41,866,855	22,428,900	16,599,000	2,181,847	657,108	657,108
	1902	6	6,235,570	....	306,486	21,737	6,563,793	2,788,550	2,737,000	383,878	654,365	632,628
California	1912	42	394,521,712	31,504,789	52,010,518	3,142,704	481,179,723	276,322,796	164,957,750	36,622,850	3,276,327	133,623
	1907	42	251,692,790	13,637,939	26,104,021	2,165,529	293,600,279	147,734,600	96,812,400	44,087,329	4,965,950	2,800,421
	1902	35	74,624,168	1,805,168	6,167,463	5,751	82,602,550	46,022,099	30,529,500	4,239,902	1,811,049	1,805,298

[1] Italic figures indicate deficits.

[2] Includes states as follows: 1907—Arizona, 4; Idaho, 2; Nevada, 1; New Mexico, 2; Utah, 4. 1902—Arizona, 1; Idaho, 1; New Mexico, 1; Utah, 3.

TABLE 165.—BALANCE SHEET OF OPERATING AND LESSOR

	DIVISION AND STATE.	ASSETS.											
		Cost of construction, equipment, and real estate.	Stocks and bonds of other electric railway companies.	Stocks and bonds of companies other than electric railways.	Treasury securities.			Other permanent investments.	Cash and current assets, including supplies.	Stock and bond discount.	Sinking and other special funds.	Sundries.	Profit and loss deficit for companies showing a deficit.
					Total.	Stock.	Bonds.						
1	UNITED STATES..	$4,596,563,292	$266,962,339	$57,774,666	$93,142,825	$30,875,789	$62,267,036	$47,370,584	$178,853,733	$67,754,310	$27,761,430	$74,362,014	$38,149,444
	GEOGRAPHIC DIVISIONS:												
2	New England	354,605,174	4,487,393	5,351,690	972,915	316,382	656,533	2,779,715	15,838,785	1,432,438	2,072,717	4,205,650	1,814,262
3	Middle Atlantic	1,471,795,717	147,788,645	23,956,798	20,404,957	8,776,552	11,628,405	9,100,961	61,520,328	14,743,535	6,411,395	45,255,651	20,736,273
4	East North Central	1,099,283,481	42,571,872	6,088,199	32,096,986	6,095,557	26,001,429	18,139,289	34,433,949	8,159,045	6,640,523	7,411,714	7,389,291
5	West North Central	336,808,451	1,372,897	496,072	11,496,359	7,342,715	4,153,644	153,124	7,884,142	4,108,058	650,116	1,435,571	390,597
6	South Atlantic	375,467,897	12,397,843	17,305,283	8,154,324	2,778,020	5,376,304	2,559,852	13,732,613	2,861,031	1,737,115	13,243,786	1,673,443
7	East South Central	124,119,747	4,449,159	107,499	2,487,200	919,998	1,567,202	3,255,418	4,863,638	1,753,225	942,840	275,267	397,074
8	West South Central	136,295,611	21,474,500	65,155	1,723,701	673,701	1,050,000	921,372	7,471,158	3,518,634	942,697	860,340	855,978
9	Mountain	90,534,736	12,494,346	1,108,012	2,829,610	1,984,010	845,600	2,156,347	2,939,971	1,165,082	537,397	293,307	633,601
10	Pacific	607,652,478	19,925,684	3,295,958	12,976,773	1,988,854	10,987,919	8,304,506	30,169,149	30,013,262	7,826,630	1,380,728	4,258,925
	NEW ENGLAND:												
11	Maine	28,479,941	3,539,674	3,086,740	587,382	4,382	583,000	27,018	1,189,855	248,552	94,972	25,145	53,607
12	New Hampshire	7,011,443			5,000		5,000	241	202,894		66,508	5,500	287,779
13	Vermont	6,073,617	71,866		312,533	312,000	533		345,853	11,000	1,067	3,064	58,718
14	Massachusetts	194,677,690	100,000	22,501	68,000		68,000		9,851,949	1,172,886	1,271,438	3,823,165	1,222,533
15	Rhode Island and Connecticut.	118,362,483	775,853	2,242,449				2,752,456	4,248,234		638,732	348,776	191,625
	MIDDLE ATLANTIC:												
16	New York	913,845,909	31,608,537	17,890,981	1,557,700	1,427,100	130,600	8,263,643	47,201,890	12,470,246	4,663,689	38,659,248	8,465,710
17	New Jersey	176,912,642	1,109,005	634,320	1,566,152	701,900	864,252	115,984	2,017,101	190,365	36,698	2,006,015	1,405,771
18	Pennsylvania	381,537,166	115,071,103	5,431,497	17,281,105	6,647,552	10,633,553	721,334	12,301,337	2,082,924	1,711,008	4,590,388	10,864,792
	EAST NORTH CENTRAL:												
19	Ohio	323,609,762	22,682,881	1,878,620	16,731,305	4,236,350	12,494,955	16,864,822	6,639,200	784,327	1,959,891	5,005,699	2,451,774
20	Indiana	193,842,423	1,400,018	3,588,608	6,270,245	287,200	5,983,045	88,333	3,102,426	1,026,081	1,641,660	276,862	341,211
21	Illinois	406,577,828	3,673,871	148,592	5,450,817	996,148	4,454,669	612,939	16,719,043	5,748,511	1,511,749	1,808,412	4,390,982
22	Michigan	109,694,970	2,870,585	153,214	2,802,459	37,459	2,765,000	2	4,072,341	163,743	535,634	80,751	138,822
23	Wisconsin	65,558,498	11,944,517	319,165	842,160	538,400	303,760	573,193	3,900,939	436,383	991,589	239,990	66,502
	WEST NORTH CENTRAL:												
24	Minnesota	60,781,293	466,550		250,500	167,500	83,000	1,304	1,306,133	10,850	466,592	68,992	93,271
25	Iowa	60,135,647	98,672	29,566	1,226,600	400,100	826,500	41,549	2,104,970	303,970	103,603	258,983	37,770
26	Missouri	158,721,248	604,000	61,800	1,312,545	23,115	1,289,430	63,000	3,386,303	2,081,466	55,108	921,952	159,873
27	North Dakota and South Dakota.	1,517,890							62,949	296,005	3,677	980	142
28	Nebraska	28,670,146	14,075	400,827	7,394,000	6,000,000	1,394,000	42,964	571,313	88,585		90,046	14,157
29	Kansas	26,982,227	189,600	3,879	1,312,714	752,000	560,714	4,307	452,474	1,327,182	21,136	94,618	85,384
	SOUTH ATLANTIC:												
30	Delaware, Maryland, and District of Columbia.	147,147,538	3,128,810	7,646,140	3,662,450	1,560,900	2,101,550	131,030	4,145,637	148,197	431,169	8,493,865	642,035
31	Virginia	66,483,222	4,247,955	1,261,597	1,613,274	50,100	1,563,174	793,259	3,369,742	2,047,359	1,009,749	717,115	791,705
32	West Virginia	34,958,364	3,676,518	273,233	617,400	617,400			2,343,999	237,708	110,193	6,358	181,689
33	North Carolina	18,819,628	901,800	3,811,385	603,381	2,301	601,080	1,631,598	964,571	398,706	66,723	967,901	19,674
34	South Carolina	12,708,219	232,760	801,876	40,500		40,500	3,965	514,464			1,494,438	4,333
35	Georgia	83,962,495	210,000	3,318,052	1,066,819	442,319	624,500		1,518,820	9,061	117,299	1,548,051	900
36	Florida	11,388,431		193,000	550,500	105,000	445,500		875,380	20,000	1,982	17,058	33,107
	EAST SOUTH CENTRAL:												
37	Kentucky	36,301,326	3,988,396		1,292,570	863,000	429,570		1,588,685	2,500	35,173	42,826	125,091
38	Tennessee	49,355,376	379,103	34,100	794,600	51,100	743,500	4,835	1,322,512	1,374,002	618,881	104,707	3,177
39	Alabama	29,239,743		73,099	187,230	5,898	181,332	2,976,594	1,644,623		249,037	127,734	53,942
40	Mississippi	9,223,302	81,660	300	212,800		212,800	273,989	307,818	376,723	39,749		214,864
	WEST SOUTH CENTRAL:												
41	Arkansas	12,985,385		6,039	200	200		51,306	714,092	576,151	60,799	76,874	
42	Louisiana	57,175,403	21,474,500	9,112	54,000	32,000	22,000		4,299,637	1,136,393	457,181	692,233	18,655
43	Oklahoma	17,456,621		50,000	653,000	25,000	628,000	11,162	529,077	1,203,511	23,950	13,021	210,970
44	Texas	48,678,202		4	1,016,501	616,501	400,000	858,904	1,928,352	602,579	400,767	78,212	626,353
	MOUNTAIN:												
45	Montana	5,957,245	449,315		33,750		33,750	531,291	308,453	20,688	49	7,921	5,637
46	Colorado	45,575,992	11,060,021	1,002,002	2,169,610	1,367,610	802,000	1,378,980	1,709,800	466,493		239,627	333,174
47	Idaho, Wyoming, Nevada, and Utah.	34,049,694	985,010	96,154	399,450	389,600	9,850	145,000	802,505		537,348	15,222	173,850
48	New Mexico and Arizona.	4,951,805		9,856	226,800	226,800		101,076	119,213	677,901		30,537	120,940
	PACIFIC:												
49	Washington	136,195,547	7,499,098	116,322	1,072,900	52,900	1,020,000	1,488,350	11,726,035	1,700	1,410,522	239,185	577,813
50	Oregon	76,935,219	22,000	258,280	1,508,756		1,508,756	1,032,426	3,235,303	297,257	298,672	170,577	538,408
51	California	394,521,712	12,404,586	2,921,356	10,395,117	1,935,954	8,459,163	5,783,730	15,207,811	29,714,305	6,117,436	970,966	3,142,704

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[1] Italic figures indicate deficits.

COMPANIES COMBINED, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

Total—Assets or liabilities.	LIABILITIES.												Net surplus.[1]	
	Capital stock.			Funded debt.	Real estate mortgages.	Floating debt.	Reserves.	Accounts payable.	Interest and taxes due and accrued.	Dividends due.	Sundries.	Profit and loss surplus for companies showing a surplus.		
	Total.	Common.	Preferred.											
$5,448,694,637	$2,379,346,313	$1,970,385,003	$408,961,310	$2,329,221,828	$6,097,245	$296,161,797	$80,775,824	$86,715,392	$54,079,730	$4,164,748	$78,695,664	$133,436,096	$95,286,652	1
393,560,739	204,443,600	180,683,350	23,760,250	129,639,840	330,842	18,164,988	7,800,359	5,965,531	3,186,926	198,521	12,845,009	10,985,123	9,170,861	2
1,821,714,260	711,998,377	636,148,840	75,849,537	801,582,533	4,229,917	145,440,259	24,623,281	28,832,197	21,306,600	1,636,360	37,115,319	44,949,417	24,213,144	3
1,262,214,349	534,303,711	424,192,308	110,111,403	589,361,398	381,621	33,613,940	19,195,564	26,238,232	12,670,095	279,555	13,536,702	32,633,531	25,244,240	4
364,795,387	159,247,520	120,920,545	38,326,975	155,092,155	605,830	20,242,651	7,710,913	7,009,328	3,080,730	16,891	1,562,000	10,227,369	9,836,772	5
449,133,187	196,567,505	151,100,605	45,466,900	205,449,168	403,100	12,888,464	5,378,276	4,463,634	3,372,881	648,389	7,746,860	12,214,910	10,541,467	6
142,651,067	57,169,564	43,966,704	13,202,860	71,296,580	22,285	3,834,783	1,717,079	1,461,861	1,970,684	500,839	887,261	3,790,131	3,393,057	7
174,129,146	86,542,205	61,655,778	24,886,427	65,691,669	58,050	10,478,500	1,847,430	1,734,341	1,387,145	378,281	1,215,894	4,795,631	3,939,653	8
114,692,409	48,204,727	40,134,552	8,070,175	46,014,459	....	8,891,811	2,276,829	1,040,321	1,241,668	290,523	665,891	6,066,180	5,432,579	9
725,804,093	380,869,104	311,582,321	69,286,783	265,094,026	65,600	42,606,401	10,226,093	9,969,947	5,863,001	215,389	3,120,728	7,773,804	3,514,879	10
37,332,886	16,041,825	11,591,825	4,450,000	19,102,382	10,075	51,923	332,808	304,571	202,752	26,500	149,169	1,110,881	1,057,274	11
7,579,365	4,163,400	4,093,400	70,000	2,322,000	12,267	210,341	270,980	81,113	31,825	36,585	328,762	122,092	*165,687*	12
6,877,718	2,848,100	2,824,350	23,750	2,813,558	....	259,289	7,695	52,194	39,460	....	12,132	845,290	786,572	13
212,210,162	93,791,575	83,732,975	10,058,600	80,728,700	307,000	15,225,123	4,138,463	4,269,163	2,577,126	135,436	6,159,116	4,878,460	3,655,927	14
129,560,608	87,598,700	78,440,800	9,157,900	24,673,200	1,500	2,418,312	3,050,413	1,258,490	335,763	....	6,195,830	4,028,400	3,836,775	15
1,084,127,553	389,019,080	354,075,580	34,943,500	481,571,770	2,440,562	108,003,068	20,342,192	20,506,312	16,204,025	1,352,651	10,506,172	34,181,721	25,716,011	16
185,994,053	76,757,176	75,157,176	1,600,000	94,932,000	232,185	6,106,208	122,813	2,891,935	1,267,325	14,453	1,012,621	2,657,337	1,251,566	17
551,592,654	246,222,121	206,916,084	39,306,037	225,078,763	1,557,170	31,330,983	4,158,276	5,433,950	3,835,250	269,256	25,596,526	8,110,359	*2,754,433*	18
398,608,281	211,767,450	162,629,150	49,138,300	138,806,040	131,600	12,920,533	7,562,861	10,256,814	2,388,574	9,018	5,294,545	9,470,846	7,019,072	19
211,577,867	101,946,135	71,742,225	30,203,910	89,385,787	42,200	5,292,138	2,375,544	1,646,378	1,405,868	60,899	5,100,097	4,322,821	3,981,610	20
446,642,744	150,734,120	129,583,927	21,150,193	256,620,427	45,663	10,651,550	2,910,479	8,429,207	7,129,932	50,835	2,613,090	7,457,441	3,066,459	21
120,512,521	41,995,506	37,726,506	4,269,000	60,111,724	156,590	3,142,776	3,338,693	3,073,682	806,322	13,928	203,535	7,669,765	7,530,943	22
84,872,936	27,860,500	22,510,500	5,350,000	44,437,420	5,568	1,606,943	3,007,987	2,832,151	939,399	144,875	325,435	3,712,658	3,646,156	23
63,445,485	32,319,200	26,674,700	5,644,500	23,580,000	5,800	446,162	3,554,053	252,826	968,679	....	552,594	1,766,171	1,672,900	24
64,341,330	28,827,219	23,851,244	4,975,975	24,708,900	65,000	5,021,335	415,366	943,535	489,514	7,873	858,715	3,003,873	2,966,103	25
167,367,295	59,298,850	40,992,150	18,306,700	79,947,200	501,830	14,436,135	2,534,540	5,032,992	1,405,995	....	38,370	4,171,383	4,011,510	26
1,881,643	1,060,350	960,350	100,000	514,555	....	60,000	28,244	123,534	20,103	9,000	66	65,791	65,649	27
37,286,113	21,584,276	13,871,376	7,712,900	13,639,000	....	108,993	1,161,105	501,935	67,922	18	66,871	155,993	141,836	28
30,473,521	16,157,625	14,570,725	1,586,900	12,702,500	33,200	170,026	17,605	154,506	128,517	....	45,384	1,064,158	978,774	29
175,576,871	63,551,800	52,797,800	10,754,000	97,156,468	10,800	2,952,158	1,259,696	688,353	1,599,151	242,043	4,519,298	3,597,104	2,955,069	30
82,334,977	34,205,600	25,530,600	8,675,000	38,125,100	4,500	2,908,772	1,892,441	2,078,062	1,169,012	240,721	85,937	1,624,832	833,127	31
42,404,462	19,621,100	16,140,300	3,480,800	18,304,900	16,300	1,256,924	455,128	370,280	252,638	100,170	463,221	1,563,801	1,382,112	32
28,185,367	15,749,300	13,482,200	2,267,100	8,174,000	10,000	1,715,194	362,243	206,719	157,623	53,701	958,752	797,835	778,161	33
15,800,555	8,972,905	7,332,905	1,640,000	4,076,400	....	1,987,964	153,160	239,434	26,752	....	64,338	279,602	275,269	34
91,751,497	48,681,200	31,181,200	17,500,000	34,248,800	361,500	1,283,658	960,030	799,201	53,156	11,754	1,616,377	3,735,821	3,734,921	35
13,079,458	5,785,600	4,635,600	1,150,000	5,363,500	....	783,794	295,578	81,585	114,549	....	38,937	615,915	582,808	36
43,376,567	18,865,030	16,341,220	2,523,810	20,397,120	4,285	1,167,524	872,833	450,263	482,409	251,438	143,186	742,479	617,388	37
53,991,293	20,701,000	13,701,000	7,000,000	28,878,000	....	1,084,069	580,003	378,572	781,696	3,775	49,731	1,534,447	1,531,270	38
34,552,002	12,997,000	9,482,000	3,515,000	17,002,500	....	1,096,608	223,874	518,325	495,699	245,489	638,642	1,333,865	1,279,923	39
10,731,205	4,606,534	4,442,484	164,050	5,018,960	18,000	486,582	40,369	114,701	210,880	137	55,702	179,340	*35,524*	40
14,470,846	6,113,120	3,642,893	2,470,227	6,552,736	50,000	267,761	133,244	183,515	247,134	32,559	69,627	821,150	821,150	41
85,317,114	45,453,314	30,016,514	15,436,800	31,922,750	6,800	2,522,377	976,265	587,689	759,249	345,722	499,219	2,243,729	2,225,074	42
20,151,312	10,844,050	8,299,650	2,544,400	7,151,000	....	1,322,711	220,411	139,837	167,388	....	82,380	223,535	12,565	43
54,189,874	24,131,721	19,696,721	4,435,000	20,065,183	1,250	6,365,651	517,510	823,300	213,374	....	564,668	1,507,217	880,864	44
7,314,349	3,632,532	2,942,532	690,000	2,514,220	....	90,022	307,919	88,068	51,973	....	6,889	622,726	617,089	45
63,935,699	24,903,550	23,679,550	1,224,000	31,280,130	....	2,286,520	738,291	573,949	705,631	190,523	416,100	2,841,005	2,507,831	46
37,204,233	15,478,945	9,642,770	5,836,175	10,614,309	....	6,486,247	1,209,361	258,311	302,386	100,000	212,832	2,541,842	2,367,992	47
6,238,128	4,189,700	3,869,700	320,000	1,605,800	....	29,022	21,258	119,993	181,678	....	30,070	60,607	*60,333*	48
160,327,472	79,319,508	59,829,975	19,489,533	56,926,500	2,100	12,083,342	5,426,148	1,284,499	1,762,965	....	668,934	2,853,476	2,275,663	49
84,296,898	25,226,800	24,872,800	354,000	43,209,776	....	10,320,283	928	1,322,830	1,210,682	....	1,361,598	1,644,001	1,105,593	50
481,179,723	276,322,796	226,879,546	49,443,250	164,957,750	63,500	20,202,776	4,799,017	7,362,618	2,889,354	215,389	1,090,196	3,276,327	133,623	51

Table 166.—EMPLOYEES, SALARIES, AND WAGES OF OPERATING COMPANIES,

	DIVISION AND STATE.	Number of companies.	TOTAL.		SALARIED EMPLOYEES.			
			Number.	Salaries and wages.	Total.		Salaried officers of corporation.	
					Number.	Salaries.	Number.	Salaries.
1	UNITED STATES	975	282,461	$200,890,939	23,271	$26,128,786	1,927	$5,708,553
	GEOGRAPHIC DIVISIONS:							
2	New England	91	34,224	23,285,975	1,991	2,329,050	144	457,562
3	Middle Atlantic	246	93,811	66,387,065	6,895	8,071,703	511	1,656,386
4	East North Central	222	66,721	47,607,646	5,414	5,774,907	576	1,466,386
5	West North Central	85	20,930	15,986,008	1,659	1,925,201	138	487,538
6	South Atlantic	107	19,958	12,501,028	2,158	2,231,507	209	555,166
7	East South Central	45	9,375	5,824,724	780	953,189	102	298,183
8	West South Central	79	8,393	5,717,503	810	901,842	72	162,055
9	Mountain	40	4,498	3,997,836	494	614,107	51	129,304
10	Pacific	60	24,551	19,583,154	3,070	3,327,280	124	495,973
	NEW ENGLAND:							
11	Maine	16	1,771	1,302,347	175	164,700	26	50,068
12	New Hampshire	13	837	512,100	68	68,599	13	14,855
13	Vermont	9	268	175,669	43	38,286	12	17,429
14	Massachusetts	43	23,169	15,680,837	1,259	1,566,180	72	321,314
15	Rhode Island and Connecticut	10	8,179	5,615,022	446	491,285	21	53,896
	MIDDLE ATLANTIC:							
16	New York	101	55,683	40,315,540	3,878	4,661,467	243	979,084
17	New Jersey	24	9,436	6,105,245	918	1,091,295	53	149,423
18	Pennsylvania	121	28,692	19,966,280	2,099	2,318,941	215	527,879
	EAST NORTH CENTRAL:							
19	Ohio	75	21,245	14,500,590	1,973	2,052,444	201	520,920
20	Indiana	34	8,553	5,444,020	797	855,057	95	214,568
21	Illinois	67	23,661	18,769,450	1,544	1,916,307	179	475,796
22	Michigan	22	9,500	6,304,409	756	628,649	76	182,242
23	Wisconsin	24	3,762	2,589,177	344	322,450	25	72,860
	WEST NORTH CENTRAL:							
24	Minnesota	9	4,267	3,782,870	485	710,790	15	157,418
25	Iowa	24	4,034	2,830,356	376	419,513	31	83,296
26	Missouri	19	9,550	7,230,808	515	462,619	32	130,489
27	North Dakota and South Dakota	5	133	98,507	14	19,197	3	6,358
28	Nebraska	7	1,579	1,159,065	108	173,705	12	59,899
29	Kansas	21	1,367	884,402	161	139,377	45	50,078
	SOUTH ATLANTIC:							
30	Delaware, Maryland, and District of Columbia	25	8,553	5,513,163	792	875,670	55	191,792
31	Virginia	18	3,563	2,040,845	482	428,080	52	150,588
32	West Virginia	21	1,939	1,192,759	154	174,261	18	42,125
33	North Carolina	13	1,282	775,076	175	152,238	30	44,376
34	South Carolina	6	794	436,369	105	57,961	17	15,457
35	Georgia	14	2,852	1,936,434	337	425,380	31	102,516
36	Florida	10	975	606,382	113	117,917	6	8,312
	EAST SOUTH CENTRAL:							
37	Kentucky	10	3,591	2,142,523	181	245,007	36	108,883
38	Tennessee	12	3,304	2,062,317	306	383,928	40	107,929
39	Alabama	11	1,973	1,317,365	230	265,460	18	69,124
40	Mississippi	12	507	302,519	63	58,794	8	12,247
	WEST SOUTH CENTRAL:							
41	Arkansas	10	755	533,151	91	83,065	9	22,380
42	Louisiana	13	3,236	1,986,691	119	147,397	13	47,253
43	Oklahoma	17	791	594,006	151	167,490	22	39,755
44	Texas	39	3,611	2,603,655	449	503,890	28	52,667
	MOUNTAIN:							
45	Montana	6	390	471,777	39	68,118	3	10,072
46	Colorado	16	2,498	2,089,255	226	272,098	25	77,950
47	Idaho, Wyoming, Utah, and Nevada	12	1,448	1,318,544	210	251,342	20	40,547
48	New Mexico and Arizona	6	162	118,260	19	22,549	3	735
	PACIFIC:							
49	Washington	19	4,761	3,716,543	624	606,629	25	64,528
50	Oregon	6	3,041	2,541,897	698	689,298	34	116,088
51	California	35	16,749	13,324,714	1,748	2,031,353	65	315,357

BY CLASSES OF OCCUPATION, BY GEOGRAPHIC DIVISIONS AND STATES: 1912.

SALARIED EMPLOYEES—continued.				WAGE EARNERS.								
Managers and superintendents.		Clerks, stenographers, and other salaried employees.		Total.		Conductors.		Motormen.		All other employees.		
Number.	Salaries.	Number.	Salaries.	Number.	Wages.	Number.	Wages.	Number.	Wages.	Number.	Wages.	
2,882	$5,376,526	18,462	$15,043,707	259,190	$174,762,153	65,726	$47,101,768	65,595	$48,349,857	127,869	$79,310,528	1
262	511,810	1,585	1,359,678	32,233	20,956,925	8,219	5,297,309	8,451	5,522,019	15,563	10,137,597	2
726	1,509,255	5,658	4,906,062	86,916	58,315,362	21,135	15,088,922	20,659	15,539,085	45,122	27,687,355	3
836	1,394,639	4,002	2,913,882	61,307	41,832,739	15,151	11,573,262	15,215	11,912,930	30,941	18,346,547	4
214	400,933	1,307	1,036,730	19,271	14,060,807	5,358	3,815,365	5,384	3,991,122	8,529	6,254,320	5
328	549,847	1,621	1,126,494	17,800	10,269,521	4,779	2,973,094	4,808	2,965,101	8,213	4,331,326	6
111	191,850	567	463,156	8,595	4,871,535	2,152	1,285,141	2,201	1,328,747	4,242	2,257,647	7
149	233,020	589	506,767	7,583	4,815,661	2,176	1,471,483	2,303	1,571,728	3,104	1,772,450	8
66	147,829	377	336,974	4,004	3,383,729	1,014	889,829	1,003	887,671	1,987	1,606,229	9
190	437,343	2,756	2,393,964	21,481	16,255,874	5,742	4,707,363	5,571	4,631,454	10,168	6,917,057	10
36	46,174	113	68,458	1,596	1,137,647	374	236,695	382	240,745	840	660,207	11
22	29,169	33	24,575	769	443,501	203	115,361	205	116,242	361	211,898	12
13	13,858	18	6,999	225	137,383	61	40,048	63	40,984	101	56,351	13
155	344,953	1,032	899,913	21,910	14,114,657	5,568	3,551,718	5,778	3,682,789	10,564	6,880,150	14
36	77,656	389	359,733	7,733	5,123,737	2,013	1,353,487	2,023	1,441,259	3,697	2,328,991	15
346	871,320	3,289	2,811,063	51,805	35,654,073	11,506	8,123,742	10,953	8,493,250	29,346	19,037,081	16
87	140,641	778	801,231	8,518	5,013,950	2,227	1,613,366	2,228	1,655,205	4,063	1,745,379	17
293	497,294	1,591	1,293,768	26,593	17,647,339	7,402	5,351,814	7,478	5,390,630	11,713	6,904,895	18
257	423,454	1,515	1,108,070	19,272	12,448,146	4,859	3,500,793	4,860	3,551,213	9,553	5,396,140	19
121	189,281	581	451,208	7,756	4,588,963	1,415	934,099	1,443	984,518	4,898	2,670,346	20
311	509,058	1,054	931,453	22,117	16,853,143	5,649	4,919,439	5,679	5,091,508	10,789	6,842,196	21
97	150,803	583	295,604	8,744	5,675,760	2,364	1,601,912	2,360	1,626,163	4,020	2,447,685	22
50	122,043	269	127,547	3,418	2,266,727	864	617,019	873	659,528	1,681	990,180	23
36	91,375	434	461,997	3,782	3,072,080	1,147	872,443	1,151	914,035	1,484	1,285,602	24
80	132,002	265	204,215	3,658	2,410,843	812	598,467	807	614,720	2,039	1,197,656	25
48	102,338	435	229,792	9,035	6,768,189	2,584	1,774,105	2,529	1,849,166	3,922	3,144,918	26
4	8,680	7	4,159	119	79,310	43	28,296	45	29,236	31	21,778	27
11	26,380	85	87,426	1,471	985,360	451	330,935	470	341,192	550	313,233	28
35	40,158	81	49,141	1,206	745,025	321	211,119	382	242,773	503	291,133	29
95	176,316	642	507,562	7,761	4,637,493	2,255	1,452,864	2,225	1,458,511	3,281	1,726,118	30
58	121,160	372	156,332	3,081	1,612,765	697	455,502	651	426,124	1,733	731,139	31
38	59,893	98	72,243	1,785	1,018,498	430	272,150	448	274,757	907	471,591	32
48	55,012	97	52,850	1,107	622,838	245	126,410	234	124,721	628	371,707	33
22	22,534	66	19,970	689	378,408	205	109,884	197	107,947	287	160,577	34
44	78,370	262	244,494	2,515	1,511,054	665	407,834	767	418,552	1,083	684,668	35
23	36,562	84	73,043	862	488,465	282	148,450	286	154,489	294	185,526	36
28	54,236	117	81,888	3,410	1,897,516	854	499,449	930	534,453	1,626	863,614	37
32	54,770	234	221,229	2,998	1,678,389	735	438,552	697	445,165	1,566	794,672	38
28	55,183	184	141,153	1,743	1,051,905	457	284,057	435	271,337	851	496,511	39
23	27,661	32	18,886	444	243,725	106	63,083	139	77,792	199	102,850	40
21	28,612	61	32,073	664	450,086	178	115,004	227	143,774	259	191,308	41
21	42,317	85	57,827	3,117	1,839,294	880	567,600	878	575,229	1,359	696,465	42
25	41,772	104	85,963	640	426,516	178	127,710	212	153,926	250	144,880	43
82	120,319	339	330,904	3,162	2,099,765	940	661,169	986	698,799	1,236	739,797	44
11	32,776	25	25,270	351	403,659	100	118,325	122	138,132	129	147,202	45
32	61,076	169	133,072	2,272	1,817,157	613	495,587	570	461,587	1,089	859,983	46
17	40,342	173	170,453	1,238	1,067,202	258	246,646	263	252,708	717	567,848	47
6	13,635	10	8,179	143	95,711	43	29,271	48	35,244	52	31,196	48
68	143,082	531	399,019	4,137	3,109,914	1,146	811,685	1,163	823,422	1,828	1,474,807	49
24	63,542	640	509,668	2,343	1,852,599	690	562,928	596	486,198	1,057	803,473	50
98	230,719	1,585	1,485,277	15,001	11,293,361	3,906	3,332,750	3,812	3,321,834	7,283	4,638,777	51

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STREET AND ELECTRIC RAILWAYS.

PART II.—TECHNICAL ADVANCES IN THE INDUSTRY.

By THOMAS COMMERFORD MARTIN, *Expert Special Agent.*

GENERAL FIGURES.

The general and detailed figures of the report show a remarkable technical advance in the industry, broadly considered, and when examined closely reveal many interesting changes of condition since the report for 1907. The small increase in the number of operating and lessor companies compares strikingly, for example, with the high percentages of gain in plant equipment, the use of electrical energy, the number of passengers carried, the use of water power, and the employment of electric locomotives in street railway service. Here is evidence of the natural tendency toward the grouping of properties into one unified system, just as the New York Central Railroad grew out of a number of lines, between New York and Chicago, at the terminal of each of which the unfortunate "through" passenger had to transfer, with great inconvenience and loss of time. Another aspect of the data is the growth in size of all the units. The miles of line and of single track increased, respectively, 82.9 per cent and 81.9 per cent in the 10-year period, but the number of cars was only 94,016 in 1912, as compared with 83,641 in 1907 and 66,784 in 1902—an increase of 40.8 per cent for the decade. Relatively, passenger cars increased even less than that—from 60,290 in 1902 to 76,162 in 1912, or 26.3 per cent—but the mere statistics are utterly misleading when one compares the small cars of 1902 with the ponderous and capacious cars of 1912 and of later date, many of them double-deckers, referred to later in this chapter. The increase in passengers carried is also much greater than that in car mileage, a fact due both to the higher density of travel within cities and to the falling off in new construction not only within city limits but also in suburban and rural territory, where the trolley is more or less of a competitor with steam railroads. Both contestants for transportation patronage in the five years seem to have suffered in some way from difficulty in raising new capital, smaller income from larger travel, and lack of the rapid expansion associated with earlier periods. And yet it is obvious to anyone familiar with the conditions that, alike in the city and in the country, the opportunity and necessity for greater transportation facilities have never been more pronounced than in the latter half of the decade ending with 1912 and at the present time. Due to this inadequacy of service, created apparently by discouragement of enterprise, there have resulted a loss of time, a lower land value of suburbs, a lesser tax assessment, and a greater congestion of population paying higher rent for less desirable homes, which if totalized and capitalized would represent a far greater sum than would have been necessary to create these facilities and pay a fair return. Such problems are somewhat aside from the technical ones here discussed, but no one can question their intimate relationship and interaction with the technique of the industry.

POWER-PLANT ENGINEERING.

Conditions described and discussed in the report for 1907 have not changed in any radical degree as to power-plant engineering except in the significant extent to which street-railway systems have ceased in a great many instances to manufacture their own electrical energy and have found it more economical and equally reliable to buy power from the local central station systems. There have, however, been several notable new plants, both steam and hydroelectric, installed during the period for the express purpose of furnishing power for electric transportation. These newer plants mark the passing away of the old "double-deck" plants so familiar in the preceding regime, when the steam engines or steam turbines were set directly over the boilers, a type of design which, from the standpoint of steam economy, is as nearly as possible theoretically correct. Another feature of the newer plants is the introduction of units whose size far outruns anything utilized in the past.

South Boston power plant.—The South Boston Station of the Boston (Mass.) Elevated Railway is a fine example of a plant designed for efficient operation with fluctuating loads.[1] It is part of the general scheme of improvement which has been under way for some years. Ultimately it is to be of 125,000-kilowatt capacity, but at present an output of only 30,000 kilowatts is being produced with two units. The tubular boilers, now sixteen in number, are rated at 600 horsepower on the usual basis of 10 square feet of heating surface per boiler horsepower. The turbine room is nearly 500 feet long and about 80 feet wide, and the boiler room is of the same length and only slightly wider. This is a remarkable fact in view of the tendency which has been evident for some time to consider the turbine room, so far as space is concerned, a mere annex to the boiler room. The liberal space allowed in the turbine room in this and other recent plants is partly to accommodate the enormous condensers; partly to provide room for as many auxiliaries on the main floor as possible, and to house the increasingly elaborate and bulky electrical switching and transforming apparatus; and partly to give ample space in which the turbines and generators may be taken apart for inspection and repair. In the Boston plant provision is made for taking care of variable loads by means of forced draft controlled by pressure regulators. These regulators, operated by variation in steam pressure, adjust automatically the speed of stoker engines as well as fan engines to suit the load requirements. The forced draft is necessarily accompanied by liberal combustion chamber space in the boilers, the tubes of which are set high, giving the fuel oportunity to burn before the gases are chilled by the tubes. The stokers, of the seven-retort type, are designed to carry several times the rated boiler load, and the fans are of similar overload capacity, so that the boilers can be forced to generate steam at a rate far greater than their nominal capacity. In fact, the present installation of 9,600 boiler horsepower is counted upon to supply steam for turbo-generators of 45,000-kilowatt (equivalent to about 60,000 horsepower) capacity. As a few boilers will usually be out of commission for cleaning or repairs, the remaining ones must evidently be ready for strenuous duty.

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[1] Electric Railway Journal, Prof. H. H. Norris, Jan. 4, 1913.

Such forcing for peak loads is now recommended practice for railway plants and in no way injures the boilers. At the same time the necessary investment is kept down. At Boston the result is evident in the small relative size of the boiler room, which is arranged with the firing aisle parallel to the turbine room. This plan has the advantage of convenience in handling and in inspection. The steam header, of 14-inch pipe, is placed in the boiler room 2 feet above the floor near the turbine-room partition and on about the same level as the turbine valves. A high-arch connection is made to each turbine, and excellent flexibility is thus assured. Steam-flow meters are connected in the boiler leads. The utility of such meters in assisting the firemen to keep each boiler steaming properly is recognized, and if the experience of such companies as have been using steam meters establishes the ruggedness of the device, a wide field of usefulness is open before them.

The electric generators are wound for the moderate voltage of 6,600, and this is doubled by means of autotransformers or compensators, which serve also as reactance coils to limit short-circuit currents. The generators are ventilated in a somewhat novel manner, the air being drawn in through large ducts terminating above the boiler room and downward through the generator by the usual internal fans. The air, thus drawn from a considerable elevation, is cool and free from dust.

Indianapolis power plant.—The new plant of the Terre Haute, Indianapolis & Eastern Traction Co. is a good example of up-to-date practice. It has two units installed in 1912–13, out of an ultimate capacity four times as great. The boilers, of which 60 will ultimately be required, are divided into three sections, with the firing aisles perpendicular to the turbine room, somewhat on the order of the familiar unit system. Twelve boilers of 520 horsepower each are installed to provide steam for two 6,000-kilowatt horizontal steam turbines. The ultimate boiler capacity of 31,200 horsepower will supply 48,000 kilowatts of rated turbine capacity. While this boiler allowance appears high, it includes provision for the very large overload rating of the turbines, which are expected to be able to deliver a maximum output of 80,000 kilowatts. The boiler tubes are set 10½ feet above the boiler-room floor, illustrating again the tendency toward liberal combustion space. The boilers are equipped with stokers and differential draft gauges. The absence of the usual coal and ash conveyors is noticeable in the Indianapolis plant, the work being accomplished by an industrial railway system. A narrow-gauge track is located over the coal bunkers and under the ash hoppers, and the cars which run upon this track are hoisted by means of two electric elevators.

Each of the horizontal turbo-alternator units of 6,000-kilowatt capacity discharges its steam into a surface condenser hung from the bottom of the turbine frame. The basement floor is thus kept clear for the accommodation of auxiliaries. The steam piping is of open-hearth steel, and the fittings are of cast steel, which is approved practice in plants using superheated steam. The header is located in the basement about 10 feet below the boiler-room floor, and the steam pipes to the turbines are brought up from below without conspicuous arches in the turbine room.

The Indianapolis station is conspicuous for the neat appearance of the turbine room. The enameled brick walls with simple ornamentation assist the management in instilling into the operatives a sense of pride in keeping the machinery in good order. The glass-inclosed operating gallery is free from the noise of the turbine room, insuring strict attention to switching and to the indications of the instruments. The simplicity of the turbine room is enhanced by the partitioning off of the space occupied by all the switch gear, which is located on several galleries, one over the other, closely adjacent to the turbine room but invisible from it.

Washington, D. C., plant.—An interesting plant which shows at a glance the progress made in steam-turbine development is that of the Capital Traction Co. of Washington, D. C., at Georgetown, with two

1,500-kilowatt, one 3,000-kilowatt, and one 5,000-kilowatt horizontal turbines. Although the smaller machines have been in use but a few years, such has been the progress in design that the 5,000-kilowatt turbine is not noticeably larger than the 3,000-kilowatt machine, or even the still smaller ones. The same condition has been shown in other plants using vertical turbines, where units of 20,000-kilowatt capacity now occupy little more floor space, except for the condensers, than did the 5,000-kilowatt machines of 10 years ago. The Georgetown plant is the result of the rapid outgrowing of former stations, and much of its equipment has been moved from them. This has, however, been so skillfully incorporated with the new apparatus that there is no evidence of patchwork.

On account of the gradual development of this plant a considerable variety of condensing equipment is found in it. The smallest turbines have jet condensers maintaining a 28-inch vacuum. A surface condenser on the 3,000-kilowatt unit holds a 29-inch vacuum, which is about the same as in the condenser of another type on the 5,000-kilowatt unit. The air and circulating pumps for the condensers are of the centrifugal type, but the boiler-feed pumps are reciprocating.

In the design of the building the architect has been very successful in producing a structure which, while it looks like a power station, would be an ornament anywhere but in a residential neighborhood. Much more attention is being given to the architecture of power plants than formerly, and it is fitting that in a vicinity containing so many handsome structures the railway power plant should be in keeping with its surroundings.

Louisville, Ky., generating plant.—A modern generating station, with an initial capacity of 12,000 kilowatts, which may be taken as one example of modern work, has been put in operation by the Louisville Traction Co., owner of the Louisville Railway and the Louisville & Interurban Railroad companies. This new station feeds the underground and overhead transmission system at 13,200 volts, 25 cycles, 3-phase, to two city substations, and to an old generating station which has been tied in with the new station, and in turn feeds six substations on the seven interurban lines radiating from Louisville. The unit system of design was followed in the construction of this new station, which will have an ultimate capacity of 48,000 kilowatts. The Louisville Railway and the Louisville & Interurban Railroad companies operate 165 miles of city track and 96 miles of interurban track, respectively. Prior to the completion of the new plant this system was supplied with electrical energy from the old plant situated on Beargrass Creek in the southeastern part of Louisville. This generating plant contained one 3,500-kilowatt and one 3,000-kilowatt steam turbine and two 1,650-kilowatt reciprocating vertical-engine-type units, all generating alternating current at 13,200 volts, 25 cycles, 3-phase. In addition to these, the old plant was equipped with two 1,650-kilowatt and three 500-kilowatt, 550-volt, direct-current generators, making a total of 14,600 kilowatts, alternating current and direct current, installed in connection with one 3,000-ampere-hour storage battery which was used as a reserve during peak-load periods.

Beargrass Creek, on which the old plant was situated and from which circulating water was obtained, received the discharge from a number of sewers. This did not materially impair the value of the water for use in the condensers, but a few years ago the city of Louisville constructed sewers parallel to the creek, and this resulted in reducing the flow of water to an almost negligible quantity. It thus became necessary for the railway company to seek a new supply of condensing water or a new site for a power station. It put off the day when it would be necessary to build a new plant and sunk artesian wells and installed a spray cooling system to furnish condensing water. These methods, with the limited amount of water supplied and the amount of pumping necessary, were costly and materially reduced the efficiency of the plant. To eliminate these difficulties and at the same time take advantage of modern generating efficiencies, it was decided to build a new station at a more advantageous location and especially where plenty of water was available.

In the meantime other difficulties arose which also tended to give impetus to the building of a new generating station. The average daily output in the existing plant increased from 35,000 kilowatt hours in 1900 to practically 150,000 kilowatt hours at the close of 1912. At the same time the maximum hourly load demand rose from 3,000 kilowatts in 1900 to 15,000 kilowatts in 1912. This rapid rise in the output was due to various causes, namely, increased car-mileage, track-mileage, car sizes, and car equipment. During 1902 the generating station output was 1.5 kilowatt hours per car-mile; in 1905 this had increased to 2.5 kilowatt hours, and in 1912 to approximately 3.9 kilowatt hours, per car-mile.

The factors entering into the location of the new plant were (1) ample condensing water supply, (2) ready access to steam railroad tracks for coal, and (3) cheap real estate for coal storage. To obtain these necessary requirements a site for the new plant was selected on the Ohio River. At a point in the river opposite Louisville the Federal Government has built a removable dam to limit the low-water stage in the Louisville Harbor. Rapids in the river opposite the city have also made necessary locks for transporting boats around the falls during low-river stages. Accordingly, property for the plant was purchased above the locks at a point where a definite minimum stage of the river could be obtained.

The new plant site fronts 1,358 feet on the Kentucky & Indiana Terminal Railroad Co.'s right of way, which adjoins the Louisville and Portland Canal. The transportation facilities offered at this location are especially desirable, because this railroad forms a part of a double-track belt line around about half the city and connects with all the steam roads entering Louisville. In addition, the general level of the plant property is approximately 5 feet above the maximum high-water stage of the river. The site is underlaid with bedrock at a depth of about 36 feet.

Switches at each end of the plant property connect with a long sidetrack paralleling the steam road's right of way. A lead from one end of this sidetrack in turn divides into five tracks, two of which lead over the coal hopper beside the boiler house, one into the boiler house, and one into the generating room under the crane. The space remaining between these four tracks furnishes sufficient area to store two or three months' coal supply in the open. This space has been graded, so that all surface water drains off readily. Approximately 30 cars of coal will be required every 24 hours for the completed station, and the yard layout of 4,000 feet of track provides for two days' supply of coal on cars at all times, with extra space for one day's empties.

The first section of the generating station includes a boiler room, 100 feet by 180 feet in plan, built with its long axis at right angles to that of the turbine room, which is 80 feet by 175 feet. This boiler room houses the initial equipment of eight 507-horsepower boilers, with spare space for a duplicate battery under the same roof. The turbine room was also designed large enough not only to house the initial installation of two 6,000-kilowatt steam turbines, but to provide space for the foundations of two additional units. The buildings are constructed of plain and reinforced concrete, brick and steel, and are thoroughly fireproof structures. They rest either on concrete caissons taken down to rock or on concrete mats resting on concrete piling driven to bedrock or to refusal. Ample provision is made for natural illumination and ventilation in the turbine and boiler rooms by large window-glass areas with steel sash. In addition, a double monitor skylight surmounts the firing aisle of the boiler room and the long axis of the turbine room.

For serving the initial installation of eight 507-horsepower water-tube boilers, a 13-foot by 255-foot dark red radial brick stack was erected on a concrete foundation resting on bedrock. This stack provides 1 square foot of cross-section for each 36.25 horsepower. The present boiler equipment generates steam at 200 pounds' pressure per square inch and 125° Fahrenheit superheat. Each unit is equipped with a chain-grate stoker having a grate 9 feet 6 inches wide by 12 feet 3 inches long. This size of grate was particularly designed to produce economical results with the Kentucky pea and slack coal used.

The stack rises to an elevation 253 feet above the grate level, and with six of the boilers in service the draft at the base of the stack has averaged 1.2 inches of water. Tests made over the front of the grates, the main breechings and the boiler dampers being open, showed pressure of 0.45 inch of water, while the draft at the last boiler pass measured 1 inch of water. A preliminary test of station efficiency during the second month's operation, before the steam piping was completely covered and while some steam was being used for drying-out and testing purposes, gave a coal consumption of 2.975 pounds per kilowatt hour, with 12.5 per cent ash. The coal used was western Kentucky pea and slack, containing approximately 12,000 heat units per pound when dry.

From the receiving track hoppers, 2-ton hand push cars convey the coal to the structural-steel bunkers over the boiler room by way of duplicate electric elevators. An industrial railway leads from the elevator shaft over the battery of bunkers, so that these cars may be pushed by hand and dumped at any point desired. The two platform elevators are of 6,000 pounds' capacity. They were designed to operate at 100 feet per minute, one being driven by a 550-volt, 30-horsepower, direct-current motor and the other by a 440-volt, 30-horsepower, 3-phase, alternating-current motor.

Each battery of two boilers is equipped with a coal bin holding 225 tons, which represents four and one-half days' fuel supply for ordinary operation. This large coal-bin capacity was deemed necessary as a precaution against shortage during extreme high-water periods when the tracks of the steam railroad might be inundated.

The ashes drop from the chain grates into two steel ash hoppers lined with fire brick and are dumped into push cars on an industrial railway. Siftings from the grates are dumped into the cars and returned to the coal bunkers. The small cars loaded with ashes are elevated to a steel ash hopper lined with fire brick, which is installed over the coal-unloading hoppers. By this arrangement, after the coal has been unloaded into the track hoppers the cars may again be loaded with ashes from the hoppers overhead.

The steam-pipe layout includes one steam header installed over the front of the boilers and at right angles to the turbine room. This header varies in size from 12 inches to 16 inches and is connected to a crossheader in the boiler room running parallel to the turbine room. Out of this crossheader steam is taken to the turbines by way of 12-inch long-radius bends. Two 10-inch long-radius bends take the steam to an auxiliary header in the basement of the turbine room, which in turn feeds all station auxiliaries. When the second row of boilers is installed a ring system of steam piping is contemplated which will encircle the boiler room so that any battery or any steam bend may be cut out of service for repairs without disturbing the other steam units.

Circulating water for the plant is taken from the canal through eight 4-foot 8-inch by 8-foot openings, the bottoms of which are approximately 50 feet below the generator-room floor, or 12 feet below normal water level in the canal. The tops of these intake openings are approximately 4 feet below normal water level, which, it is hoped, will prevent to a certain extent the clogging of the intake screens by floating trash. Just inside the intake openings in the canal walls there are cast-iron racks set at 20 degrees from the vertical and composed of 4-inch by 1½-inch bars with 2-inch openings between them for screening off logs and large trash. Manholes are provided over each of these racks in the intake structure, so that any trash collected may be hauled out with a long-handled fork.

A duplicate set of screens is installed in a screen house on the railway company's property, approximately 90 feet from the intake. At the screen house, which measures 18 feet 6 inches by 30 feet 4 inches in plan, the intakes flare to provide supports for stop planks and a double row of movable vertical screens. The latter have been installed with four double screens in each of the four channels. The sizes of the openings for both intake and discharge were figured for a flow of 160,000 gallons per minute, or 20,000 gallons per minute for each of the eight units in the initial station installation. At this rate of flow, the openings produce a discharge speed of only 1.19 feet per second, such a reduction having been necessary in order not to interfere with small boats passing in the canal.

Two 30-inch cast-iron pipes are laid over the outside walls of each intake conduit. These pipes are continuous from taps in the discharge-water conduit to the inlet at the canal end of the intake and were provided to protect the intakes from clogging with needle ice. Valves installed in these cast-iron connections may be opened and hot water discharged into the canal at the mouth of the intakes. As the hot water is taken from the discharge conduit, the only expense involved is that of maintaining the pipe line from the turbine room to the intake structure at the canal.

The turbine room and its basement for the auxiliaries measure 174 feet long by 61 feet 6.5 inches wide, with four galleries on one side, 21 feet 10.5 inches in width. The turbine room is served by a 50-ton crane. Each turbine foundation consists of two parallel walls resting on bedrock and extending to within 18 inches of the main turbine-floor level. These walls are so placed and spaced that the surface condensers may be dropped in place under the turbines by the overhead crane. The turbine proper rests on an I-beam grillage, supported in turn on the two concrete foundation walls. Special attention was given to the design and installation of these turbine concrete foundations, in view of the fact that their bases are below water level in the river.

The circulating pumps are installed 45 feet below maximum high water and only 1 foot above the low-water stage of the Ohio River. This has made it necessary to seal all pipes into the concrete conduit to prevent flooding during high water, when all the waterways inside the building are under very great pressure.

Each of the 6,000-kilowatt horizontal steam turbo-generators is equipped with a 20,000-square-foot surface condenser. Circulating water is supplied to each condenser by a 26-inch tri-rotor centrifugal pump, driven by a steam turbine. Each has an emergency 30-inch pipe connection to the circulating pump of the other turbine. The units are arranged in pairs with condensing auxiliaries in a pit between the two foundations. Thus the first two units are spaced 45 feet apart and the second and third units are 30 feet apart. In this way one operator can care for the auxiliaries of two units. This arrangement also permits sets to be cross connected more readily and economically. The dry-vacuum pumps, the main circulating pumps, and the hot-well pumps are connected and arranged so that either generating unit may be used with either of the auxiliaries. A 4-inch, two-stage hot-well pump driven by a 27-horsepower steam turbine completes the steam-turbine equipment.

The turbo-generators deliver 13,000-volt, 25-cycle, 3-phase energy, which is transmitted over the feeder lines at this same bus pressure. Regulators control the voltage of the main alternators, the excitation energy for which is supplied by a 30-kilowatt motor-driven direct-current set and by one 100-kilowatt and one 150-kilowatt steam-turbine-driven exciter set.

The first 2,000-kilowatt rotary converter has been installed on one of the foundations provided for it beside the auxiliary pit, and feeds the trolley sections in the vicinity of the new generating station. This substation equipment is tied in with the two city substations by way of a 600-volt direct-current trunk line. This installation required three 750-kilowatt, single-phase, oil-cooled, step-down transformers rated at 13,200/440 volts.

A four-level gallery adjoins one side of the turbine room. On the lowest level, which is below the turbine-room floor, the conduit carrying the underground transmission cables is brought in from the street. From the conduit the cables radiate through the necessary cable-end bells, supported from a central concrete wall which also carries the transformer compartment. This compartment extends the full length of the turbine room and is completely separated from the basement under the turbine-room floor by a 13-inch brick curtain wall. All openings between this gallery and the turbine room are fitted with doors, so that the space may be entirely closed and used as an air chamber to supply air to the turbines. An air intake is provided outside of the station at one end of this lower gallery, and air is taken into this chamber by way of louvered openings. After the air passes through the intake into this lower gallery it is screened through one-fourth-inch mesh copper screens covered with cheesecloth and set at 30° to the direction of the air current.

A machine shop is situated on the main-floor gallery along with the tool room and store rooms and the oil switches controlling the high-tension generator and feeder circuits. These 13,200-volt switches are installed in the concrete switch and bus structure, which is built in two parallel sections. At the present time these two sections are divided at their mid-point, so that there are four sections of the high-tension bus. The bus and feeder arrangement is such that each section of the bus connects one generator and four feeder switches. Each generator has two oil switches in series, while each feeder is provided with a single oil switch. Disconnecting switches are provided in each phase and on both sides of each oil switch so any one may be cut out of service for repairs or cleaning.

The complete high-tension bus structure was built for 4 generating units and 16 feeders. The structure itself has been erected for the complete station. All generator switches are nonautomatic, and the feeder oil switches and junction bus section switches are automatic and provided with inverse time-limit relays.

Large turbo-generator units.—The turbines for the Interborough Rapid Transit Co. of New York, exemplifying some of the latest advances in steam use for electrical energy generation, are unusual, not only for their size but also because of the fact that each set is made up of two units, one operating with high-pressure steam at 1,500 revolutions per minute and the other receiving the exhaust from the former and running at 750 revolutions per minute. Each set has a combined capacity of 30,000 kilowatts, but owing to the enormous amounts of power required by the whole system the new units can be operated at the most economical load during the major part of the time, and therefore they were designed to give the very highest obtainable efficiency, nearly regardless of their cost—the only essential superior to this desideratum being reliability in operation.

Turbines of 30,000-kilowatt capacity may be designed in single units, operating at 750 revolutions per minute. Such machines would be relatively economical and would probably show a steam-consumption performance higher than has hitherto been obtained. The turbine cylinder structure, however, on account of the slow rotative speed, would be relatively large, and this, together with the temperature differences existing within the one structure, would involve in a machine of such large capacity an engineering problem of some magnitude. Similarly, both steam turbine and generator of this capacity might be designed and constructed to operate at 1,500 revolutions per minute. In this case the structure would be less gigantic, but in order to avoid congestion of the steam in the low-pressure portions of the turbine, and to permit it to expand efficiently down to the very low limits of condenser pressure, 29-inch vacuum in this instance, blade speeds rather beyond what has hitherto been considered the limit of good practice would be involved. Either of these would be a combination type machine, comprising an impulse element for the first expansion, followed by an appropriate number of reaction elements for the low-pressure stages, the latter being arranged for double flow.

The highest degree of economy, however, is not to be obtained with an impulse element, as compared with a reaction element, provided the steam volumes, speed, etc., are appropriate for the design of the reaction turbine; but in any reaction turbine designed for high-expansion ratios the problem of having to deal with relatively minute volumes of steam at the high-pressure end and enormous volumes at the low-pressure end is serious, the increase of volume being roughly on the order of a geometric progression. It is evident that if the high-pressure portions of a turbine may be operated at twice the rotative speed of the low-pressure portions, this problem is largely eliminated, and the capacities and speeds in this particular application, where the high pressure is a single-flow turbine, operating at 1,500 revolutions per minute, and the low pressure is a double-flow turbine, operating at 750 revolutions per minute, point to the possibility of designing plain reaction machines which will have an efficiency beyond anything yet constructed. The blade speeds involved are low, and either turbine element is of exceedingly simple mechanical construction, involving no new engineering problems and thoroughly fulfilling the first desideratum of absolute reliability.

The scheme of employing two turbine elements having the steam pass serially through them is not new. A number of such units of from 1,000-kilowatt to 2,000-kilowatt capacity were built in 1901. This construction has again come to the front in the case of the English-built turbines for the Commonwealth Edison Co. of Chicago. It is new, however, to employ high-pressure and low-pressure elements driving separate generators, each at a different synchronous speed.

There are other advantages in dividing large turbines into two separate elements besides those due to employing different speeds. The temperature range in either element is reduced. A sufficient number of stages may be introduced to give the very highest efficiency without any mechanical difficulties, such as increased length between bearings, etc. Some little advantage is to be gained by separating between the two turbine elements the water which has been precipitated in the steam expansion. Either element is more reliable and simple, because of its smaller size. There is some slight loss of efficiency due to the employment of two generators instead of one of twice the capacity, but this is more than overbalanced by the gain in economy due to the operation of the two turbine elements at different speeds. It is guaranteed that each set will deliver energy at the terminals of the generator equivalent to 75¾ per cent of that available in the steam.

Interurban light and railway plant.—A tendency toward the occupancy of a broader field of service has been shown among interurban electric railways. The Cleveland, Painesville & Eastern Railroad, for example, has adopted the policy of entering the lighting field in the towns traversed by its lines, as the company believes that the benefits gained by the recent consolidation of its plants in the railway field may be extended to the other branches of public service. The town of Willoughby, Ohio, where the company's headquarters are located, has a municipally owned plant and current is bought by it from the railway company at the switchboard. Power in large quantities, however, is sold directly to users by the railway company. From Willoughby, lighting lines are extended to Wickliffe on the west and Mentor on the east. From a substation in Painesville are fed the towns of Perry, Richmond, and Fairport, and the Geneva substation supplies Madison, Unionville, and Saybrook, the average run being about 8 miles on each side of the generating plant or substation. The company has secured lighting loads of over 250 kilowatts in the towns of Willoughby and Mentor, and this without making any extensive campaign for the business. It is contracting with several municipalities to pump their water supply. The rate charged for lighting is 11 cents per kilowatt hour, less 2 cents discount if paid on or before the tenth of the month. Power rates are based on a sliding scale, depending on the load factor. They vary from 5 cents per kilowatt hour to 1¾ cents per kilowatt hour, with a guaranteed minimum of $1 per month per horsepower of connected load. Another schedule in force makes use of a maximum demand meter, with the same rates for installations over 50 horsepower in capacity, in which case the customer furnishes the transformer equipment and buys energy on the high-tension side at 2,200 volts. The entire railway traverses a well populated, fertile country, abounding in agricultural and dairy products and having great natural beauty. About 40,000 people are located in the territory served by the line.

The power house is located in the town of Painesville, Ohio, on the bank of Grand River. It consists of a main building approximately 97 feet by 105 feet and an annex 42 feet by 21 feet. The chimney is of radial brick, 200 feet in height and 13 feet in inside diameter, built to take care of an ample increase in boiler capacity. Coal is obtained over the tracks of the Lake Shore & Michigan Southern Railroad, and the method of handling it is one of the unique features of the station. A steel hopper with a capacity of 500 tons which receives coal direct from railroad cars is built into the trestle over which pass the tracks of the electric railway. The railroad car containing the coal is taken out on the trestle between the scheduled time for the interurban cars by a home-made electric locomotive, and the coal is dumped direct into the hopper, the entire unloading being accomplished in a period of about 10 minutes. The hopper has sufficient capacity for approximately 10 days' supply. The locomotive is weighted down with steel punchings from the shop and is equipped with two 50-horsepower motors and automatic air brakes. It will haul two gondola cars of coal at each trip and obviates the necessity of sending a work car and its crew from the car house at Willoughby whenever it is desired to unload coal. From the hopper the coal descends by gravity into cars on a track beneath. These run into the boiler room upon an elevated track located above the stoker hoppers, and the coal is dropped into the stokers as required. The average consumption is about 40 tons a day.

The ashes drop into brick-lined steel hoppers equipped with gate valves of the same type as those used for the coal. The ash tunnel is located directly under the furnaces, and ash cars run from there to an elevator, where they are hoisted to an outside track. The ashes are used for filling in the low ground adjacent to the power house. The ash cars are interchangeable with those used for hauling the coal.

The boiler plant consists of three batteries of two 166-horsepower boilers each, aggregating 2,200 horsepower in actual capacity.

Cooling water for the surface condensers is taken from the Grand River, and the siphon circulating system used possesses some novel features. A pump house is located on the bank of the river, approximately 350 feet from the power house. It is of brick, 26 feet by 17, and, owing to its proximity to the river, it was found impossible to secure even a clay foundation on which to build it. Consequently, it was constructed in the form of a reinforced concrete basket set on concrete piling.

In order to secure an uninterrupted supply of circulating water, free from all débris, a concrete intake box having two sets of screens was sunk near the edge of the main channel of the river. The upper portion of the box is covered with a perforated caisson built of boiler plate and having a screen bolted to the top, so that, even when flood waters completely cover the intake, clean water can be secured. The intake box is connected with a 24-foot storage well just outside of the pump house by a 48-inch tiling some 80 feet in length. The water before entering the well passes through another box equipped with double screens, and it has been found that an ample supply of clean water is assured without the use of the twin strainers or similar appliances usually introduced in circulating lines.

The pumping equipment consists of two 14-inch centrifugal pumps, each having a capacity of 500 gallons per minute and driven by a 50-horsepower, 440-volt, induction motor. These motors are controlled entirely from the power house, although air-break switches are installed at the pump house for use in case of emergency. It is unnecessary, therefore, for anyone to visit the pump house except for purposes of inspection.

Each pump has a separate suction pipe to the well, but they both discharge into a single 20-inch main leading to the power house. The various condensers receive water from this single main and discharge it into another single 20-inch main, which leads back to the river, making a complete siphon system. These pipes are of cast iron, having flanged joints, and they are laid in a 6-foot concrete tunnel extending from the power house to within 75 feet of the pump house. Gate valves operated from the turbine floor control the supply and discharge lines to each condenser, so that any condenser may be taken off the line for purposes of inspection or repair without breaking the siphon effect of the circulating system. At the same time these permit regulation of the amount of water used in the condensers under various operating conditions. A combination wet and dry pump is installed to start the system if for any reason it should become empty of water. The discharge pipe to the river is provided with a Y connection to insure a supply of warm water in order to get rid of any needle ice which may gather at the intake in the winter.

Owing to the fact that the system embraces a siphon, the motor-driven pumps have only to overcome the friction of the complete circulating system, thus calling for considerably less expenditure of energy than if they had to work against the entire head. A steam-driven centrifugal pump is also installed at the pump house for cleaning out the well, and a telephone line between the pump house and the power house affords a ready means of communication when anyone has occasion to visit the pump house for the purpose of inspection.

All of the valves used in connection with the engines, turbines, and condenser equipment are controlled from the engine-room floor, so that the engineer does not have to leave the floor, but can control all machinery therefrom.

Great importance is attached to the value of tests, and one is being run all the time to ascertain just what is being done and what results are secured. Accurate records are kept of coal, water, and ash, so that the operating efficiency can be computed at any time. A water meter accurately measures the boiler-feed water, the ashes are weighed, and the percentage of ash in the coal is obtained. The total operating force consists of 11 men, working in two 12-hour shifts.

The scheme of painting the piping around the station in different colors facilitates greatly the work of the employees, as one can tell at a glance just what the pipe is carrying. Live steam is indicated by green, exhaust steam by brown, hot water by red, cold water by black. The engine-room walls are painted white, with a green border.

The generating equipment consisted formerly of two 360-kilovolt-ampere, 25-cycle generators, direct connected to two 18-inch by 36-inch by 42-inch engines delivering current at 6,600 volts. The natural increase in load, however, and that due to extensions and other business secured, required additional station capacity, and the following apparatus was installed in 1912: Two 1,670-kilovolt-ampere, 25-cycle, 6,600-volt turbo-generators operating at 1,500 revolutions per minute, and two 50-kilowatt, 125-volt turbo-exciter sets, together with a 22-panel switchboard.

The switchboard is located on a raised portion of the floor overlooking the remainder of the engine room. A swinging bracket at the end contains two voltmeters, a frequency meter, and a synchroscope. Each generator panel is equipped with an ammeter, a voltmeter, power-factor meter, watt-hour meter, field rheostats, and nonautomatic oil switches. The high-tension feeder panels are equipped each with three ammeters, a watt-hour meter, an automatic oil switch, and relays. Four panels are devoted to the control of the exciters, with the usual equipment of ammeters, voltmeters, rheostats, and knife switches.

A substation, consisting of two 360-kilovolt-ampere, 600-volt, direct-current rotary converters and a portion of the main switchboard devoted to their control, is located in the power house. The main transformers are arranged in two banks, each having three 500-kilovolt-ampere units, located in the basement. They step up the voltage from 6,600 to 13,200 for transmission to the other substations at Willoughby, Geneva, and Ashtabula. It has been proposed, however, to raise the transmission voltage to 22,000.

Evolution of Minneapolis plant.—The evolution of the steampower plant of the Twin City Rapid Transit Company in Minneapolis is a good example of the rapid changes which have taken place generally in the methods of power production in the street railway field. Originally this plant contained triple-expansion Corliss engines, representing the best practice of 20 years ago, and these engines were connected through jack shafts to 150-horsepower generators, large for the time. This equipment produced electrical energy at high cost for fuel, because the nature of the load did not permit the engines to be used under good operating conditions, and also at high cost for maintenance, on account of the complicated character of the machinery. Ten years ago a modern steam plant was designed to contain ultimately five vertical cross-compound reciprocating engines of 5,000-horsepower capacity, direct-connected to 3-phase, 13,200-volt, 35-cycle generators rated at 3,500-kilowatt capacity, or at, say, 4,000 kilowatts on the now standard temperature rise. Three of these engines were installed by 1905, giving the plant an actual capacity of 12,000 kilowatts. The engines were supplied from a boiler room containing 18 standard water-tube boilers with 5,560 square feet of heating surface each, giving a nominal rating of 556 horsepower. These were equipped with stokers of a continuous capacity of 825 boiler horsepower to produce a 50 per cent overload output of the boilers. The boilers contained superheaters of a capacity to produce 120 degrees superheat at rated load. Draft was furnished by two radial-brick stacks, 162 feet high, mounted on masonry 63 feet above the boiler-room floor. The flue diameter was 16 feet. Two flues, each of 125 square feet cross-section, connected the boiler uptakes with each stack.

Following the original plan, a fourth engine and eight more boilers were added in April, 1906. By this time, however, the steam turbine had entered the field; and instead of the fifth reciprocating engine, two 5,000-kilowatt vertical turbines were installed in February and July, 1907, respectively, in the place provided for it. The fact that this space accommodated turbines with three times the capacity of the engines which could have been installed therein is significant. No increase in boiler capacity was made. The plant was typical of the best practice of the time. Hardly had the new turbines been installed, however, when it was found possible to secure larger and more economical ones, and the process of replacing the engine units began. In the meantime experiments had been made with chain-grate stokers, and in January, 1909, two, in July four more, and during the fall six more, were installed. By this time the stack capacity was greatly overtaxed, and one of the brick stacks was replaced, in November, 1910, by two brick-lined steel stacks, with internal diameters of 14 feet, mounted on structural-steel frames over the boilers. Their tops were 265 feet above the boiler-room floor. A 4,000-kilowatt vertical steam-turbine unit was put into service in February, 1911, and in July six more chain grates were installed. Two more boilers, of 5,000 square feet heating surface, were added in the space formerly occupied by masonry stack foundations, and the remaining furnaces were equipped with chain grates. Again the stacks were overtaxed, and the second brick one was replaced with two steel ones in August, 1912. During the following month a 15,000-kilowatt turbine set displaced the second engine. More steam being required, two more boilers were added in January, 1913, in the space formerly occupied by the second brick stack. The installation of a third large turbine, also of 15,000-kilowatt capacity, was completed in 1913, and but one engine of the original four of 1906 remained in service. The story of advance and obsolescence was practically complete.

Combination steam and hydraulic plant.—The Northern Ohio Traction & Light Co.'s plant of 1913 illustrates the combination of steam and hydroelectric service in one system for the supply of electrical energy. It includes a steam station with a present rating of 20,000 kilowatts and an ultimate rating of 50,000 kilowatts, a hydroelectric station of 2,000-kilowatt rating, eight substations, and the necessary transmission lines. The company owns and operates approximately 216 miles of single track, consisting of the city lines in Akron and Canton and the interurban lines from Akron north to Cleveland, south to Canton, Massillon, Urichsville, Canal Dover, etc., east to Kent and Ravenna, and southwest to Barberton and Wadsworth. In addition, it supplies electricity for all services in the city of Akron and numerous towns and villages on the railway lines. The latter business has developed more rapidly during the past few years than the company's facilities for handling it, and in several instances the proffered business has necessarily been refused. The gross receipts of the company during 1912 exceeded those of 1911 by 11.2 per cent.

The company's Gorge power station, supplemented by the hydroelectric station, replaces stations at Akron, Silver Lake Junction, and Bedford, and furnishes all energy required north of Canton. The existing stations at Canton, generating alternating current at 25 cycles, however, continue to supply the city lines in Canton and the interurban lines south of Canton. The Gorge station is located in the valley of the Cuyahoga River, just below the Cuyahoga Falls, Ohio. As the low-water flow of the Cuyahoga River was not sufficient for condensing purposes, it was necessary to build a dam so that a suitable pond for cooling water would be provided; and as the fall of the Cuyahoga River is quite rapid at this point, it was found possible, by utilizing the head from this dam in connection with a fall below the dam, to secure a head of about 100 feet one-half mile below the dam.

The coal for the station is delivered over the Pennsylvania Railroad, the only railroad near the site. The company has a siding from this road which runs along the top of the river bank at an elevation about 90 feet above the boiler-room floor. A trestle with coal bunkers underneath allows loaded cars to be shifted by the company's motor car. From the bunkers the coal passes through valves into the crusher and through this crusher into individual bunkers for the boilers.

The power station proper consists of the boiler room, 56 feet wide by 330 feet long, and the turbine room, 63 feet wide by 227 feet long, separated by a division wall, the turbine room being on the river side. The turbine room was located on this side in order to decrease the length of the condensing-water tunnels and also to simplify the delivery of coal to the boiler room. In addition, there are two small wings, in one of which are the blowers for the forced draft and in the other are the lightning arresters.

The main floor of the boiler room, which is flush with the basement of the turbine room, is placed at elevation 918.5 (above sea level), which is about 40 feet above the head of the stream and about 90 feet below the top of the bluff, where coal is delivered. The dam, which is about half a mile below this station, has its spillway at elevation 910, so that low water would only be 8 feet 6 inches below the turbine-room basement. During the famous 1913 floods in Ohio the water rose to elevation 918.2.

The boiler room contains sixteen 604-horsepower tubular boilers and superheaters, arranged in a single row, the stack being placed in the center of the boiler room, with eight boilers on one side and eight on the other. All boilers are equipped with stokers. Fans, located in the blower room, just south of the boiler room, furnish the forced draft for these stokers. The ashes are dumped into ash pockets underneath the grates and thence into a small car running on a track in the basement.

Steam at a pressure of 200 pounds is used with a superheat from 75° to 90°. Each boiler is equipped with recording instruments in order that a complete comparative record of coal consumption and steam furnished may be kept. The radial-brick stack is 275 feet high. The stack is unusually high because the station is about 90 feet below the surrounding country. There are two openings for the breeching, each 20 feet high and 7.5 feet wide. The novelty in its construction was the use of $\frac{1}{4}$-inch American ingot iron plates.

The main steam header has been so arranged that the boilers may be divided into four groups, one or more of which may be out of service at any time. All nozzles were welded on by an electric arc.

The main steam piping consists of a 12-inch header in the boiler room, connected to the boilers by 8-inch compound bends. This header is connected to the three turbines by 12-inch leads, each of which is provided with a suitable separator at the lowest point and an angle valve adjacent to the throttle valve. This arrangement allows the separator to drain the header at all times, whether the turbine is in service or not. There is an 8-inch auxiliary header in the turbine-room basement, connected to this 12-inch header at three points, from which all connections are taken to auxiliaries.

A 50,000-gallon steel tank set on the bluff just above the station, with a head of about 100 feet, supplies the general service water, the cooling water for transformers, the water lines for cooling ashes, and the fire lines.

Air piping has been carried throughout the building, as compressed air is used in cleaning the generators, rotaries, etc., in the turbine room, and for operating turbine tube cleaners in the boiler room.

The oil piping for the transformers is so arranged that the oil from any transformer may be removed through pipe to barrels which are set in a pit at one end of the pipe line; or, in case of fire, this oil can be run to a pit outside of the building.

The installation of generating equipment consists of three 6,300-kilowatt, 2,300-volt, 60-cycle, 3-phase turbo-generators, 1,800 revolutions per minute, directly connected to three horizontal double-flow steam turbines, with a guaranteed steam consumption not to exceed 14.8 pounds per kilowatt hour at 100 per cent of rating and 15.4 pounds at 150 per cent. Space has been provided for two additional similar or larger units in the future. Two 150-kilowatt steam-driven exciters have been installed with an extra motor-driven unit. These exciters are placed on the turbine-room floor between main units and directly in front of the main switchboard.

The exhaust from the turbines discharges into steam condensers, which are in the basement, immediately underneath the turbines. The circulating and air pumps for these condensers are on a single shaft and are driven by a 228-horsepower steam turbine. As there was a possibility that at some time the level of the pond would be drawn below the spillway of the dam, single-stage booster pumps were provided in the turbine-room basement, near the condensers, driven by 75-horsepower, 2,300-volt, 3-phase motors.

Three boiler-feed pumps driven by steam turbines have been provided in the basement of the turbine room. The pumps normally take their water from three feed-water heaters placed on a platform midway between the turbine-room floor and the basement floor. The feed-water heaters are filled from the hot-well or discharge tunnel by means of two pumps directly connected to motors. Two service pumps directly connected to motors, each having a rating of 150 gallons per minute, are also located in the basement. These pumps are used in filling the service tank on the bluff.

The electrical operation of the station is controlled from a gallery about 40 feet long on the river side of the turbine room. A bench board on this gallery contains 14 panels. Three of these are used for the control of the main units, two for the exciters, three for outgoing high-tension lines, three for 2,300-volt lines to substation No. 3, one for 2,300-volt lines to the booster-pump motors, and two are blank for future connections. Indicating and recording instruments are on vertical panels above the bench board.

The structure for the busbars and oil switches is on the main floor under the front of this gallery. The ends of this structure are inclosed, forming a room in which the high-tension circuit-breakers are installed. The main cables from the generators are carried under the turbine-room floor to the 2,300-volt busbar. From this bus cables lead to three 3,000-kilowatt transformers. The transformers are located in the turbine-room basement directly beneath the switchboard gallery and step up to 22,000 volts for the outgoing high-tension lines which feed the substations mentioned before. The high-tension cables pass through ducts in the turbine-room floor to the lightning-arrester room. In this room are installed three sets of electrolytic lightning arresters. Directly above this room is a transmission tower which is the starting point for all lines. Substation No. 3 is located in the northwest corner of the turbine room and consists of three 500-kilowatt, 6-phase, 60-cycle rotaries and three step-down transformers, which are fed directly from the 2,300-volt main busbar. The switchboard for this substation contains the necessary panels for the rotaries and outgoing feeders. Sixty-cycle rotaries were finally selected for this service to avoid frequency changes, in view of the fact that remarkable progress has been made during the past few years in their design. Additional panels for switches and circuit-breakers for lighting and auxiliary motors are placed on the turbine-room floor near the substation board.

Combination railway, lighting, and ice plant.—There are some instances where the steam generator plant of a street railway, besides being available for traction, lighting, and industrial motors, has been applied directly or through an intermediary to ice-making, especially in the South. The Louisville, Ky., plant may be cited as one example. Another illustration is the plant of the Newport News & Old Point Railway and Electric Co., where the reconstruction of the engine equipment, introducing turbo-generators, has carried with it improvements in the ice-making apparatus. The ice plant, adjacent to the power house, had a rated capacity of 100 tons of ice and contained two ammonia compressors, one a 40-ton, 14-inch by 28-inch tandem-compound condensing machine, and the other a 60-ton, 16-inch by 24-inch tandem-compound condensing machine. The 40-ton freezing tank had fallen into disuse, and, owing to inadequate auxiliaries, both compressors were operated on the 60-ton tank during hot weather without getting full capacity. The plant has now been completely overhauled, and recent records show that with an outside temperature of 100° in the shade a regular output of 105 tons of ice per day can be maintained aside from the refrigeration of storage rooms, estimated as equivalent to 3 tons or 4 tons of ice production. The new atmospheric ammonia condensers were constructed out of the old atmospheric condenser of the 40-ton equipment by adding ejectors and sprinkling troughs. The stands are 20 feet long and are made up of 2-inch pipes 12 pipes high. Seven stands were erected for the 60-ton and five stands for the 40-ton compressor. Each stand takes approximately 60 gallons of water per minute. The coolers are of construction similar to that of the condensers, but are made of standard-weight galvanized-iron pipe, and consist of three stands for the 40-ton equipment. These are supplied from the same water and pumps as the condensers, but use only 30 gallons per minute per stand.

The 40-ton freezing tank, containing 12,880 feet of 1½-inch pipe and 596 300-pound cans, which was formerly operated on the dry-gas system, has been changed to a wet-gas system by installing a 30-inch by 8-foot accumulator set down in the tank. A 6-inch space underneath the tank was filled with fine regranulated cork by blowing it in with compressed air and thoroughly sealing it with waterproof paper and hard pine. The sides, which were formerly of wood and were badly decayed, were replaced by walls of hollow tiles and 8 inches of regranulated cork. The 60-ton freezing tank, containing 12,036 feet of 1¼-inch pipe and 720 300-pound cans arranged for the flooded system, was changed to a wet-gas system by the addition of two 20-inch by 8-foot accumulators. New handling rooms of 450 square feet and 750 square feet, respectively, were prepared for the 40-ton and 60-ton tanks, and these, together with two storage rooms of 680 tons capacity, are refrigated by direct expansion.

The storage tanks are cooled by direct expansion and not by passing the return gas from the freezing tanks through the coils. Each tank contains 300 feet of 2-inch pipe, and the water leaves these tanks at 40° Fahrenheit for the freezing cans.

HYDROELECTRIC DEVELOPMENT.

There are not many examples of huge hydroelectric development intended solely for the utilization of their electrical energy in street railway work, or even in the electrification of steam railroads; but on the other hand there are very few, if any, electric power-transmission systems without a railway "load." Thus the plant of the Mississippi River Power Co.,[1] at Keokuk, Iowa, with an initial capacity of 108,000 kilowatts, transmits energy at 110,000 volts 140 miles to St. Louis for street railway operation; and the 54,500-kilowatt plant of the Pennsylvania Water & Power Co. on the Susquehanna River at Holtwood, Pa.,[2] transmits energy at 70,000 volts 40 miles to Baltimore to provide a part of the power for operating the street cars of that city. The circuits of the Pacific Gas & Electric Co. ramify over more than half the state of California, and a large proportion of the current generated at its plants and fed into the circuits is employed in transportation.

Tallulah Falls, Ga., water power.—The Georgia Railway & Power Co., of Atlanta, Ga., has built an unusually large hydroelectric system at a point on the Tallulah River known as Tallulah Falls, the region and locality being one of the most famous summer-holiday resorts of the South. This is the only large development at high head east of the Mississippi, if one excepts

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[1] See p. 99, Central Electric Light and Power Stations, for full description of this plant.

[2] See p. 98, ibid.

Niagara, where the head is only one-third as high. Six hundred feet of fall is unusual anywhere, and to find a large installation working at this head in the southern Appalachian country is impressive. The present installation consists of five 17,000-horsepower turbines, each connected to a 10,000-kilowatt generator. The general construction of the system is typical of the development of high heads, except that advantage was taken of the topographical conditions to build a 110-foot dam above the natural falls of the stream. Below the dam is a tunnel cut-off, nearly a mile and a quarter long, through solid rock, terminating in an artificial forebay of concrete and steel, from which drop five 60-inch penstocks, a little over 1,000 feet long, to the wheels below. Another interesting feature of the plant is the storage pond and its appurtenances. The reservoir is about 6 miles above the head works, where a 90-foot dam has been thrown across the stream, impounding more than 1,000,000,000 cubic feet of water. This pond renders available, when it is drawn upon, a considerable power, and the plans include an auxiliary plant at this point containing two 3,000-kilowatt units to utilize the water drawn from storage and transmit the energy to the main line below. At the main dam, provision has been made for keeping the head constant during floods by the installation of automatic swinging flashboards controlled by counterweights so as to hold the elevation of the pond back of the dam practically constant.

The generators are on vertical shafts with the weight carried in suspension from oil-pressure bearings at the upper ends of the shafts. There are five 17,000-horsepower turbines, each direct connected to a 10,000-kilowatt generator. Energy is transmitted over a steel-tower, copper-line circuit at 110,000 volts to substations at Atlanta, Newnan, Lindale, Gainesville, and Cartersville, all of the modern outdoor type, the Atlanta receiving substation being the largest of the kind anywhere in the world. It is close to the city limits, with a present rating of 30,000 kilowatts and an ultimate of 60,000 kilowatts in 110,000/11,000-volt transformer equipment. The distance from the falls to Atlanta, which has a large trolley street-car system thus served, is 87.5 miles.

Bull Run plant of Portland, Oreg.—A recent typical plant on the Pacific Northwest coast is that of the Portland Railway Light & Power Co. in the rocky gorges of the Bull Run River, 28 miles from Portland. The plant derives its energy from the two confluents of that river, the Little and Big Sandy, which, together with the Bull Run itself, drain an area of approximately 521 square miles.[1] The drainage basin extends away up into the Oregon Forest Reserve, and in the case of the Big Sandy, to the melting snow and ice of the glaciers on Mount Hood. The Sandy and its tributaries drain the western slope of the Cascade Mountains in the northern part of Oregon.

The Bull Run River supplies Portland with its drinking water. A Government reserve, which carries the name of the river, was created by Congress as a protection for the city's water supply. Two steel pipes, 54 inches and 42 inches in diameter, carry the clear, cold water of the Bull Run to Portland. Although the power plant is on the banks of the Bull Run, the water necessary to operate it comes from the Little Sandy, a branch of the Bull Run, and the Big Sandy, about 7 miles above its junction with the Bull Run. As the Little Sandy could only furnish a small percentage of the total amount of water needed during the low-water months, a "hogback" mountain, known as the "Devil's Backbone," was pierced, and from the portal of this tunnel opening on the Big Sandy side a flume 12 feet by 8 feet 6 inches, approximately 1.42 miles long, connects with a 32-foot-high, 300-foot-long, timber-crib, rock-filled dam, set in concrete abutments. The headworks of the intake to the flume at this dam consist of two timber gates, 5 feet by 10 feet, set in the abutment section. The main tunnel is about 4,700 feet long, 10 feet 11 inches by 10 feet 8 inches, lined with timber, and opens up on the Little Sandy side above a diversion dam of concrete, 13 feet high and 114 feet long, 17½ feet thick through apron, and 18 inches wide at top. Thence the water is carried through a 9-foot 6-inch by 6-foot 10-inch flume, 3.25 miles long, to the forebay or reservoir of 1½ acres. In this reservoir are three concrete intakes to the 9-foot penstocks that supply water to the turbines in the power house 325 feet below. The reservoir site is to a large extent a natural one, but in order to increase its storage facilities an earth-rock, riprap-faced dike was erected around two sides of it. The storage available here is sufficient for 48 hours' operation of the plant in case of an accident to the flume.

The 9-foot penstocks are 1,400 feet long, and for the first 475 feet of their length run in tunnels under the reservoir. Just outside the portals of these tunnels, standpipes 5 feet in diameter and 42 feet high, topped with surge tanks 15 feet in diameter and 15 feet high, are riveted to the penstocks to take care of any vacuum stresses, surging, or water-hammer action that might be set up, due to opening or closing of the huge butterfly valves located in the concrete intakes in the reservoir or to the sudden taking off of the load on the generators in the power house.

The penstocks run in trenches, with concrete anchors located at frequent intervals. About 140 feet from the power house, each 9-foot penstock branches into two, 6½ feet in diameter, each feeding a water wheel.

Provision has been made for four units, and three are installed. Each of the two 6,400-horsepower, 514-revolutions-per-minute wheels consists of a single 42-inch wheel mounted on a horizontal shaft and arranged to discharge into a cast-iron quarter-turn. The wheel is inclosed in a cast-iron spiral flume casing, the neck end of which is 54 inches in diameter. The gates through which the water is discharged into the buckets are of the wicket or spring pattern type, so designed that the head of water on the wheels is always tending to close them. As these turbines are of single-runner type, it was necessary to take care of end thrust. This was overcome by means of a water-step bearing in the neck of the quarter-turn, of sufficient diameter to take the full end thrust of the wheel when working under operating head. The water for this thrust bearing comes from the penstocks supplying the wheels, but is cleansed by being forced through a strainer so arranged that it can be cleaned without having to be dismantled. In addition to the hydraulic method of taking care of the end thrust, there is also installed an oil collar bearing. On the outside of the oil chambers a water jacket is installed to prevent the oil from heating. The governors are of the vertical type, with oil pump and pressure tank. The pump is driven from the shaft of the water wheel by means of a belt. It is possible to obtain regulation as close as 6 per cent. The governor is driven by a silent chain and can be controlled electrically from the switchboard.

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[1] Electric Traction, July, 1913, Vol. IX, No. 7.

The other turbine wheel is what is known as the scroll case, single-runner, horizontal-shaft type, guaranteed to deliver 6,000 brake horsepower at 514 revolutions per minute under 320-foot head. The operating mechanism of the gates is of the wicket type and so balanced that under ordinary operating conditions they do not require a very large force to open or close them. They can be operated by hand with the oil-pressure governor. The case covering the runner is of cast iron, of a spiral form, split on the horizontal diameter.

With this wheel also the thrust bearing can be removed without disconnecting the piping to it. To take care of the thrust, an automatic hydraulic piston is keyed to the shaft and held in position by a bronze sleeve extending through the stuffing-box. Penstock pressure is utilized against this bearing. Relief valves and bursting plates have been installed on the supply pipes to the several units to take care of the changes in pressure caused by fluctuation in turbine speeds or a sudden dropping of the load.

The electric equipment consists of three 3,750-kilovolt-ampere, 3-phase, 60-cycle, 6,600-volt alternators, direct connected to the wheels before mentioned. The exciter units are both 150-kilowatt, compound-wound, interpole machines, 250-volt, 720 revolutions per minute, direct connected to 300-horsepower turbines. The pipes supplying water to the exciter turbines are so arranged that they can be run from either pipe line.

The station switchboard is located on a gallery directly over the exciter sets, where is mounted on a bench board the remote-control apparatus for all switches. Over the bench board, supported by three hollow cast-iron posts, is located a board containing the indicating ammeters, wattmeters, etc. A space about 2 feet wide from the bottom of this board to the top of the back of the bench board allows the operator a full view of the main operating room. To the left of the bench board, on an ornamental pedestal that can be seen from almost any point on the gallery, are located the station frequency indicator, a synchroscope, and a voltmeter. Against the back wall on the gallery are located the panels on which are mounted the graphic recording instruments, all relays, and regulators for the entire station. A doorway in the wall back of the gallery and a little above the level of the gallery floor opens into a building that contains the low-tension switching room and busses.

The 6,600-volt cables from the alternators are carried in fiber conduits up through the first floor of this building. In this room are located all current and potential transformers. On the next floor above is the switch room proper, containing all the 6,600-volt switches, and above them the 6,600-volt busbars are carried between concrete barriers. Each bus structure controls two generators and one transformer bank, arranged for separate or multiple operation. Located in this room is the station fuse board, containing all current, potential, and operating circuit fuses or links. The leads from this board go to the operating switchboard. On the lower floor is installed a storage battery for operating the switches. Coming up through the oil room, in which are located the transformer oil tanks, oil pumps, and filters, the visitor enters the transformer building immediately in the rear of the low-tension switching rooms. The lower floor contains the transformers, each installed in a concrete compartment. A track connecting with the main line runs into the building on the level, a transfer track running at right angles with it. A 40-ton crane is used for lifting the transformers to the transfer track. Single-phase, 3,000-kilovolt-ampere, oil-water-cooled, 6,600/57,100-volt transformers are used. A reserve transformer can be cut in, in case of emergency. The floor of the transformer compartments is sloped toward the rear, and emergency drains take care of the scattered oil in case of the bursting of the transformer shell.

On the second floor of the transformer building is the high-tension switching equipment. From the oil switches the leads are carried straight up through choke coils and roof cones to the transmission line. Two electrolytic lightning arresters are located on this floor, the horn gaps of which are on the roof. Separate leads from the horn gaps through another set of roof cones extend directly down to the arresters.

The water system that supplies cooling water to the transformers is so arranged that by means of a manifold valve system there is virtually a duplicate service. Any break in either will not cause a shut-down of the transformers on account of lack of water. The oil system is provided with two means of supply to each transformer. One of them is an emergency supply for use only in case of accident; the other can be used to fill or to drain the transformers.

The power plant thus comprises three structures—the generator, the low-tension switching, and the transformer buildings. All are of reinforced-concrete construction. The generator room is 150 feet by 44 feet by 39 feet high; the traveling crane rail is 31 feet above the floor level. The low-tension switching rooms are 53 feet by 33 feet by 12 feet high. The transformer building is 88 feet by 53 feet by 49 feet high, containing two stories. The roof is supported by a steel truss, and the crane rails lie on arched buttresses.

The station lighting is furnished by tungsten lamp clusters in ornamental iron brackets, the lighting wires being run in conduit. In case of trouble the lighting system would not be interrupted, as the wiring system provides for emergency supply from the storage battery.

Hydroelectric energy for Massachusetts trolleys.—A very interesting example of tying together steam and hydroelectric plants for the operation of street railways is afforded by the Worcester (Mass.) Consolidated Street Railway System, in which a variety of old and new steam-generating stations have been supplanted and supplemented and the service revolutionized by the entrance of the 66,000-volt lines of the Connecticut River Transmission Co. into the district. The large energy consumption of such an extensive railway network makes it a desirable customer for any wholesale manufacturer of electrical energy, its demands for service extending over at least 18 hours a day. The Worcester Consolidated Street Railway serves the second largest city in Massachusetts and a tributary suburban and rural district extending from Fitchburg on the north to the Rhode Island state line on the south. It operates about 90 miles of track in the city of Worcester and 170 miles outside, its schedules demanding the daily rush-hour use of about 400 cars and meeting the traffic requirements of a territory about 40 miles long by 30 miles in width. On its lines are operated both a passenger service, varying in density from that required in the most congested city street to that suitable for cross-country or interurban service, and a rapidly growing electric express business.

For many years the principal source of power on the Worcester system was steam in various plants using the old reciprocating engines. In 1911 an important change was inaugurated by the building of a 5,000-kilowatt steam-turbine station at Millbury, 6 miles south of Worcester; the construction of a 3,000-kilowatt rotary-converter substation on Madison Street, in the heart of the city of Worcester; and the building of a 13,200-volt, 25-cycle, steel-tower line between these points. The Millbury station was planned for the ultimate addition of several units of the capacity initially installed, and a second 5,000-kilowatt turbo-generator set has been added.

Since the Millbury steam station was placed in operation, the important high-tension hydroelectric transmission system of the Connecticut River Transmission Co. has been extended into the southern part of Worcester County, and a contract has been made for the supply of energy to the Consolidated Co. at a number of points, the most important of these being at Millbury, which has thus become the operating energy headquarters of the Connecticut River Transmission Co.'s system in that region.

The yearly output of the plants connected with the Connecticut River Co.'s lines exceeded in 1912–13 that of the combined central stations of Massachusetts, with the notable exception of the Boston Edison Co., whose system covers a large part of the state. The water-power generating stations of the Connecticut Co. are located on the Connecticut River at Vernon, Vt., and on the Deerfield River in the Shelburne Falls district. The rating in 1913 of the hydroelectric station of the Connecticut Co. and its affiliated interests on the Connecticut and Deerfield Rivers was about 35,000 kilowatts.

The transmission lines form a loop from Vernon to Shelburne Falls and back through the Fitchburg, Clinton, Worcester, Millbury, and Brookfield districts, with various branch lines and an extension loop through Rhode Island to Providence, and thence back to Millbury via northeastern Connecticut. On the north side of the system the lines between Vernon and Millbury are designed for 66,000 volts and are operated at this pressure, while on the south the lines from Shelburne Falls to Millbury and thence to Providence are designed for operation at 120,000 volts. The frequency is 60 cycles. The system is already the most extensive power system in New England deriving its energy from water wheels, and its line arrangements are being carried out with the object of providing continuous service in face of every emergency which can be foreseen. Each of the main lines carries two 3-phase transmission circuits. Steel-tower construction is employed on all the high-tension trunk lines. At the Deerfield River plant, reservoir capacities aggregating 7,000,000,000 cubic feet are laid out to insure absolute uniformity in the water supply for power generation.

Energy is furnished to the Worcester Consolidated Street Railway System from the Connecticut River Transmission lines through substations at Millbury, Greendale, Fitchburg, Leominster, West Berlin, Northboro, and West Boylston, Mass., the attendance at the Greendale and Fitchburg installations being provided by the transmission company in connection with the operation of adjoining substations for its own commercial customers' service. In addition to the Madison Street substation in Worcester, the railway company operates distributing substations at Oxford, Webster, Leicester, and Sturbridge.

The Consolidated Co.'s steam generating plants have an aggregate capacity of 18,300 kilowatts, including the second 5,000-kilowatt turbine set at Millbury. The company also purchases about 330 kilowatts from the Worcester Suburban Electric Cos. at the Uxbridge generating station of the latter, so that the total auxiliary steam power available is about 18,630 kilowatts. Generators belted to water wheels and having a combined capacity of 500 kilowatts are installed in the Leominster power station of the railway company.

In general the substations on the south side of the Consolidated System are equipped with 25-cycle rotaries, while those on the north side use 60-cycle machines. At Millbury 13,200-volt lines between the Connecticut River System and the Consolidated plant provide for the supply of current at both frequencies from the water-power system. The Madison Street substation contains two 1,500-kilowatt, 25-cycle rotaries, and two 2,000-kilowatt, 60-cycle rotaries, each pair being supplied with energy through transformer banks and an independent 3-phase No. 0 copper line to Millbury, 6 miles distant.

The steam-generating plants of the Worcester Co. are as follows: Millbury, 10,000 kilowatts; Fremont Street, Worcester, 5,650 kilowatts; Unionville, 800 kilowatts; Charlton City, 400 kilowatts; Northboro, 650 kilowatts; West Berlin, 225 kilowatts; Leominster, 800 kilowatts (not including 500 kilowatts in water-wheel driven generators). The Millbury station is the only one of these which measures up to the most modern standards, and the smaller plants are useful in their reserve capacity only in relation to the power supply throughout the system. The smaller stations contain generating units of moderate capacity, frequently belt driven, and with boilers hand fired. While most of the engines are of the condensing type, the local load factors are not favorable to high steam economy, and coal supply is expensive.

The installation at Millbury includes the Consolidated Co.'s power house, a switch house for the railway company's 13,200-volt service lines on the further side of the Blackstone Canal, the Connecticut River Transmission Co.'s substation, and in connection with this, one of the most advanced outdoor types of switching and transformer installations for high-voltage service. The entire high-tension equipment, including transformers, oil switches, and lightning arresters, connected with the 66,000-volt and 120,000-volt lines of the transmission company, is located in the open air at the rear of the substation building. The transformers will eventually have three independent windings, of 120,000, 66,000, and 13,200 volts, respectively, and the station will serve as a tie-in and equalizing center between the 66,000-volt and 120,000-volt systems, and also as a step-down substation, taking energy from either or both systems and delivering it at 13,200 volts. The ultimate capacity will be about 20,000 kilovolt-amperes. There has been installed a complete switching equipment for the control and interchange of two 120,000-volt lines and two 66,000-volt lines, with the usual protective apparatus. Space is provided for four, and possibly six, 120,000-volt lines for future service. A special steel structure has been designed by the engineers of the hydroelectric organization for the support of the outdoor busses. It consists of square towers, A-frames, and latticed girders, assembled in combinations to suit the various requirements. In a brick building are installed the 3,000-kilovolt-ampere, 60- to 25-cycle, frequency-changer set, all the control panels for the Connecticut River Co.'s high-tension and low-tension apparatus, the bus structures for the 13,200-volt, 60-cycle and 25-cycle service, and low-tension lightning arresters. The station has an ultimate capacity of twelve 13,200-volt feeders, six of each frequency, and the installation consists of six 2,000-kilovolt-ampere, 66,000/13,200-volt transformers of the water-cooled type, the frequency-changer set with a 3,000-kilovolt-ampere, 3-phase transformer, and a portion of the switching apparatus.

The 120,000-volt Connecticut Power lines between Shelburne Falls and Millbury are carried on square, double-circuit steel towers, measuring 50 feet to the lowest cross-arm and 75 feet over all. The line is 60 miles long, and the towers are spaced about ten to the mile. The power conductors are of No. 00 medium-hard-drawn 7-strand copper with a ground wire of ⅜-inch double-galvanized steel strand. Suspension insulators are used, the number of disks being six in suspension and seven on strain. The line is transposed once every 20 miles, and the telephone circuit is carried on a separate pole line. In connection with the Millbury installation, a tie-line has been constructed between the Greendale substation and the former point around Lake Quinsigamond, a distance of about 11 miles, two 3-phase circuits of No. 2, 3-strand copper being used.

The steel bridges supporting the bus conductors at the Millbury switching station are in general carried 30 feet above the ground and are about 60 feet long. Disconnecting switches are installed on both sides of every oil switch. All transformers, high-tension lightning arresters, and oil switches are mounted upon concrete foundations, and the lightning arresters are installed with tanks coated with white paint to keep the electrolyte cooler when in the sun's rays than is feasible with the ordinary dark-colored tank. A concrete pier carrying three 66,000-volt oil switches is 16.5 feet long, 4 feet wide, and 3 feet high above the ground. A typical transformer pier consists of two concrete beams 20 inches wide and 22 inches above the ground in each case, carrying two 4-inch T rails 3 feet 6 inches apart, upon which rests a set of wheels permitting the more rapid movement of the transformer in case its location has to be changed quickly. Circulating water from the Blackstone River is supplied to the transformers through a system of 3-inch pipes by two triplex vertical pumps, each geared to a 5-horsepower, 110-volt, 3-phase induction motor. The water is filtered and is drawn from a well at the pump house. Wooden galleries facilitate the opening and closing of disconnecting switches from below. The disconnecting switches are composed of suspension insulators, with a hinged blade at one end and a Y-shaped spring clip at the other. Several 13,200-volt, 60-cycle feeders connect the Consolidated Co.'s switching station with the Connecticut River Co.'s substation, and in addition a feeder of this voltage leads from the frequency changer. The minimum spacing between high-tension conductors in the open-air switching station is 8 feet, and in most cases 10 feet. Choke coils are in series with the high-tension oil switch leads, and horn-gap and electrolytic arresters are liberally provided.

The frequency changer consists of a 3-phase, 24-pole, 2,300-volt, 60-cycle synchronous motor rated at 4,250 horsepower and directly connected to a 10-pole, 3,000-kilovolt-ampere, 25-cycle, 13,200-volt generator with auto-transformer, the speed of the unit being 300 revolutions per minute.

The Madison Street substation in Worcester is noteworthy through the use of 2,000-kilowatt, 60-cycle, rotary converters. These machines were among the first of their size placed in electric railway service for 60-cycle operation. Each occupies a space 10 feet 11 inches long by 9 feet 3 inches wide, the extreme length of the machine along the shaft and including the end-play being 11 feet 7.5 inches. Each has 18 poles and operates at 400 revolutions per minute, having 6-phase connections on the alternating-current side. On the direct-current side the machines each deliver 3,333 amperes at 600 volts at normal rating.

The incoming lines from Millbury terminate in a lightning-arrester house adjacent to the substation, from which underground cables are run to the second story of the latter. With 15-inch spacing between conductors, one line is carried on insulators supported on 1½-inch pipe framing, 12.5 feet above the floor, to 15,000-volt automatic oil switches. The leads from the switches thence pass through wall bushings of porcelain to the transformers supplying the two 60-cycle rotaries. Corresponding switches control the transformers for the 25-cycle rotaries, which are supplied from the other incoming line. The current transformers are placed in the incoming lines just inside the cable potheads, and an automatic oil switch is included in each line, disconnecting switches being installed between the main-line oil switches and those controlling the sets of transformers for each rotary. Individual current transformers are provided in each transformer primary circuit. The oil switches controlling each bank of transformers for the 60-cycle service are housed in concrete compartments 31 inches long and 12 inches wide per phase, the over-all width being 50 inches. Trip coils are installed at the rear of the compartments, and the ends of the latter are protected by vertical concrete slabs 56 inches high and 6 inches wide, which also serve as foundations for the pipe framing of the local disconnecting switches and current transformers. The oil switch and bus room is 120 feet long.

The transformer installation consists of three 700-kilovolt-ampere, 13,200/430-volt air-blast units for each 2,000-kilowatt rotary and two sets of three 550-kilowatt air-blast units for the smaller rotaries. All are located on top of a brick air duct in the second story of the building, immediately above the operating room. The transformer room is 126 feet long by 14 feet wide, and the air duct is 6 by 9 feet in outside dimensions, with a division wall between the two fan systems.

The Leominster, West Boylston, West Berlin, and Northboro substations are each supplied with energy from the Clinton substation of the transmission company through a 3-phase No. 1 copper line carried on a wooden-pole line owned by the Consolidated Co. Disconnecting switches are installed at convenient points in these lines for sectionalizing purposes. The poles are chestnut, 35 feet in length, set on the average 100 feet apart, and the line is supported on porcelain insulators carried on 10-foot cross-arms. The substations are of standard type, the 300-kilowatt rotary being the usual unit of equipment. The West Boylston installation is representative and consists of two 300-kilowatt rotaries, six 110-kilowatt, 13,200/370-volt oil-cooled transformers, two 45-kilowatt reactance coils, and a four-panel switchboard 5½ feet long, housed in a concrete and brick building. The incoming line is brought through choke coils and selector switches with multigraph lightning-arrester connections, the transformers being arranged in a single row with the rotaries in front. The usual direct-current feeder equipment is installed on the switchboard panels. Automatic oil switches are installed in the transformer primary leads, and practically the entire equipment is in sight on the working floor of the building. The telephone facilities include both public and private lines. At Fitchburg a 300-kilowatt rotary converter with three 110-kilovolt-ampere, oil-cooled transformers and auxiliary equipment is housed in a 19-foot by 21-foot brick extension of the Connecticut River Transmission Co.'s main 9,000-kilowatt substation in the outskirts of the city. A switchboard with two 16-inch panels, one for the alternating-current and the other for the direct-current side of the rotary, is in service, a single 500,000-circular-mil feeder being all that is needed for the Consolidated service in that district.

At Northboro a typical substation built in connection with an established steam-generating plant held for auxiliary service is in operation, with two 300-kilowatt rotaries, transformers, and auxiliary apparatus installed in a section of the engine room 19 feet by 55 feet. In this substation the arrangement of incoming line and choke coils is unusually straightforward. The wires are carried on insulators supported on pipe framing after being brought into the building through roof bushings housed in 30-inch by 36-inch inclined openings. The choke coils are mounted on horizontal axes on insulating supports carried on the framing, and the utilization of space otherwise of no value is of interest. The negative and equalizer busses are installed under the floor of the substation, and the switchboard controls the direct-current supply to feeders for cars operating in the Marlboro, Northboro, Westboro, and Shrewsbury district.

The Worcester Co.'s double-circuit, 33,000-volt line construction employs a standard pole about 35.5 feet high above the rail. The high-tension wires are spaced in 36-inch equilateral triangles, and are carried on pin-type insulators on 7-foot and 12-foot cross-arms with metal braces. The feeders are carried on 5-foot arms spaced 24 inches apart; the trolley brackets are 9 feet 6 inches long on tangents, and telephone cross-arms 3 feet long are provided immediately above. At crossings, double cross-arms are installed and the insulators are spanned by line-wire protectors.

At Millbury Junction, Mass., the 66,000-volt lines of the Connecticut River Co. cross the tracks of both the Consolidated Co. and the Boston & Albany Railroad. The arrangement of suspension insulators in the steam railroad crossing deserves mention. Each phase wire is attached to three insulators at the ends of the cross-arms of 75-foot steel towers anchored on each side of the span, the latter being about 170 feet in length. The conductors are hung 10 feet apart in a vertical plane and about 16 feet apart horizontally. Five-disk suspension insulators are used to carry the No. 00 line wires employed. The 25-foot span across the Consolidated track is effected by the use of a pair of A-frames about 50 feet high, with pin-type insulators.

The Fremont Street station, containing the original engine-driven generators of the Worcester lines, now has seven engine-driven units, all of the cross-compound condensing type, fed by twelve water-tube boilers. This station has a coal-storage yard of 20,000 tons capacity, alongside the main line of the Boston & Albany Railroad in the southern part of Worcester. An extensive coal-handling system is in service at this point, but no further description need be given of the company's steam plants, as they are gradually being retired in favor of the hydroelectric service, with the exception of the modern turbine station at Millbury. Hourly cars are operated on the principal streets of Worcester throughout the night, and the trolley is maintained alive elsewhere. All substations are shut down about midnight and started about 5.30 a. m. At the Charlton City plant one of the existing double-current generators is utilized as a rotary converter in the autumn. The night service is handled from Worcester.

Hydroelectric development at low head.—A striking instance of hydroelectric development at very low head, for street railway work, is afforded by the power station of the McKinley System on the Illinois River at Marseilles, Ill., one of the largest and earliest of its kind in hydroelectric work. The plant contains six 74-inch turbines, two 40-inch turbines, and six 62-inch turbines. The 74-inch turbines operate at 75 revolutions per minute and are rated at 450 horsepower each, at 11-foot head. These vertical units drive direct-connected alternating-current generators, two 60-cycle and four 25-cycle. The 62-inch turbines are arranged in two groups of three each, one driving a 450-kilowatt, 60-cycle generator, the other a 500-kilowatt, 25-cycle generator. The small turbines are directly connected to 90-kilowatt exciters, while a 100-kilowatt motor-driven exciter is used for relay purposes. The 25-cycle and 60-cycle systems are tied together by means of a 750-kilowatt frequency changer operating at 300 revolutions per minute.

The power plant supplies two general transmission systems, one a 25-cycle system furnishing all power requirements for the Chicago, Ottawa & Peoria Railway, the other a 60-cycle system supplying the Northern Illinois Light & Traction Co., which furnishes light and power in Marseilles and Ottawa, the La Salle Lighting Co. at La Salle, and power and light in the towns of Spring Valley, Utica, Seneca, and Morris. The hydraulic plant operates in parallel with three steam plants, one at La Salle, one at Ottawa, and one at Marseilles. It is thus possible to maintain a high load factor on the hydraulic plant while water is abundant. A feature of the 60-cycle transmission line is that a large portion of it was constructed with concrete poles. This line is built on a right of way along the bank of the Illinois-Michigan Canal.

As the head under which this plant operates is so low, special care was taken to conserve the water supply by reducing losses at every point. Trash racks with wide bars, pointed on both sides, were specially designed, and these were set against a concrete apron 1 foot below water level for the purpose of preventing the transmission of heat from the water to the cold air above, by way of the steel bars, and the resultant formation of ice on the latter. The forebay, tailrace, and river excavations were all laid out to minimize friction losses, and the speed of the wheels was so determined as to give maximum efficiency at the head used. Special generators had to be designed for the low speed of 75 revolutions per minute, but this was considered justifiable in view of the higher hydraulic efficiency obtained.

DYNAMO CAPACITY AND PURCHASED POWER.

The capacity of the dynamos installed in electric railway plants increased from 1,723,416 kilowatts in 1907 to 2,508,066 kilowatts in 1912, but it is obvious that it would have increased much more had not there been so strong a manifestation of the tendency toward purchasing power from outside sources, either central stations or power-transmission systems. Of such practice the censuses of 1902 and 1907 made no mention, because of the fact that it had not established itself, while there was also operative a contrary policy in the acquisition of such plants by the electric railways. In the intervening period the "trolleys" would appear to have had all they could do to finance themselves in meeting the growing demand for transportation facilities as such, and the managements in a great many cases have evidently reached the conclusion that it is more economical to buy the energy needed to move the cars than to produce it from plants of their own. In other words, the real problem of street railway management is better transportation and not power production. The extent to which this notable change had gone in 1912—to be more significantly evidenced in the figures of 1917—is shown by the fact that while the output of street railway plants was about six billion kilowatt hours, the current purchased amounted to very nearly three billions. Various inferences and implications depend upon such remarkable figures, the chief of which is the suggestion, already being put into effect, that in the gradual electrification of the steam railroads it will not be necessary at all for them to build expensive power plants of their own at isolated points to supply long sections of track. They can now buy current fed in every few miles, purchased at a low rate from local central stations or power-transmission lines. It is generally believed among electrical engineers that this change of method is one of the most vital and important factors in assisting the steam railroads to make the change to electricity, while avoiding altogether unnecessary investment in duplicate power plants. Elsewhere in this report are given a number of examples of the manner in which this momentous change is being worked out in practice by large railroads and street railway systems.

Electric power appears to be almost universally purchased in alternating-current form, owing, no doubt, to the fact that the substations for supplying the direct-current overhead lines of street railways have to be located solely with regard to the requirements of the railways, as well as to the fact that the present 600-volt rotary converters taking alternating current and necessary to supply the average track voltage in direct current are not available for any use other than that of railway service. There are, however, several cases where power companies have been in a position to build and equip substations mainly to carry the direct-current loads of railways, and in such cases no difficulties either in operation or in arrangement of terms for the service to the railways have been apparent.

The cost of electric power for street railway operation is a much more important matter for the larger city systems with their long hauls and liberal transfer privileges than it is for the smaller, shorter roads; and on the systems which have contracted for large blocks of purchased power the details of the contracts have necessarily been worked out with considerable care. In general, such contracts take the form of an agreement whereby the final price paid by the railway is based upon a combination of two charges. The first of these charges is made to cover the interest and depreciation of the power company's plant and is independent of the amount of power furnished. This is variously called the demand charge, the service charge, the stand-by charge, or the primary charge. It is established by the maximum amount of energy which is demanded by the railway. In other words, the charge is made because the power company holds itself in readiness to serve the railway with a certain amount of energy, and for that reason is presumably reserving a certain amount of steam and electrical equipment to carry the railway load whenever the demand comes.

This demand charge appears to be fairly well established at a figure close to $1 per month, or $12 per annum, per kilowatt of demand. This provides, theoretically, for a return of 12 per cent upon the investment of $100 per kilowatt capacity of the equipment which has to be installed to take care of the maximum peak load called for by the railway. In practice, however, the actual rate of return from the demand charge is subject to a number of important factors. The maximum demand seems never to be based upon the instantaneous peaks and but seldom upon the one-minute or five-minute peaks, the hourly basis affording a simpler method and one less liable to material errors. Naturally the establishment of the maximum peak from the average load during an hour places the burden of carrying the sudden swings which always occur in railway loads upon the power company without compensation. Approximately speaking, the necessity for providing for the instantaneous peaks eliminates the possibility of rating the generators upon their maximum momentary capacity, as much of this overload capacity of the machines is thus absorbed.

Another factor influencing the real percentage of return afforded by the demand charge is the necessity for providing spare units as a reserve against breakdown. This excess of capacity may, of course, be reduced in the cases of the very large stations, but even in plants of 80,000-kilowatt to 100,000-kilowatt capacity a margin of about 10 per cent seems to be considered to be the minimum. The proper amount of reserve capacity is, of course, actually dependent upon the size of the units in proportion to the total capacity of the plant, as well as upon the relation of the overload capacity of the prime movers to the extent by which the maximum swing is in excess of the hourly peak or whatever other arbitrary figure is used as a basis for the demand charge.

In addition to the demand charge there is another component which enters into the final price paid for purchased power. This is variously called the energy charge, the unit charge, the kilowatt-hour charge, or the consumption charge. It consists of a charge made for each unit of energy, or kilowatt hour, actually used by the railway, and for large consumptions it is usually made as a flat rate per kilowatt hour.

There is, of course, an opportunity for wide variations in the establishment of the energy charge. With large plants the over-all efficiency is approximately constant, and the labor charge for operation can vary but little, even in widely separated localities where wage scales are radically different. The cost of fuel, however, constitutes a large part of the energy charge, in some cases even 70 per cent, and as the price of coal is subject to wide variations in accordance with the locality, the energy charge is really not capable of being estimated, even roughly, for any particular case without a knowledge of all conditions surrounding it. It is, however, an interesting fact that in three of the largest power contracts yet made the energy charge amounts to about 0.4 cent per kilowatt hour consumed.

The combination of the demand charge and the energy charge takes care automatically of variations in load factor. A railway load, with very high peaks in the rush hours, will naturally have a high demand charge, and the final price paid for power is larger than that paid when the demand charge is relatively small, owing to low rush-hour peaks and a relatively high load factor. With a load factor of 30 per cent and a demand of 1 kilowatt, the monthly energy consumption will be 216 kilowatt hours, and the energy charge at 0.4 cent per kilowatt hour will amount to 86.4 cents per month, the number of kilowatt hours per month being determined by multiplying the total number of hours in a month by the demand in kilowatts and by the load factor, or 720 by 1 by 0.30. If the demand charge is $1 per kilowatt of demand per month, the total cost of power will be made up by adding the two charges together and will amount to $1.864. As the energy consumption amounts to 216 kilowatt hours, however, the final price will amount to $1.864 divided by 216, or 0.863 cent per kilowatt hour.

If, under the same conditions, the load factor is raised to 50 per cent by reducing the demand to 0.60 kilowatt and maintaining the energy consumption at the original figure of 216 kilowatt hours, the demand charge is reduced to 60 cents per month, while the energy charge remains at 86.4 cents per month. The total cost of power per month will then be $1.464, and this divided by the monthly consumption of 216 kilowatt hours gives a final price of 0.678 cent per kilowatt hour. This final price per unit of energy is more than 20 per cent below that obtained in the former case, where the load factor was only 30 per cent. Both prices are based upon charges which should be obtainable under all ordinary circumstances when power is purchased in quantities such as would be represented by demands of, say, 10,000 kilowatts or over.

The basis for power contracts outlined is so widely used that in some respects it may be considered as a standard. Actual contracts, however, modify the figures to some extent. To present an example of the general trend, the power contracts of the Chicago City Railway, the Cleveland Railway Co., and the Philadelphia Rapid Transit Co. have been compared.

The contract of the Chicago City Railway was made in 1908 and those of the Cleveland and Philadelphia systems were closed during 1912. The term of contract in all three cases is, however, specified as 10 years. The character of current supplied by the power company is thoroughly standardized. At Chicago and Philadelphia current is supplied in 3-phase, 25-cycle form. At Cleveland 3-phase, 60-cycle current is furnished, the substations of the railway company being equipped with specially designed 1,500-kilowatt rotary converters suitable for this frequency.

The voltages for the three systems are, respectively, 9,000, 13,200, and 10,000 to 11,000. In the Cleveland contract the specifications for voltage are modified by a clause to the effect that the voltage shall have "reasonably close regulation for railway purposes, provided the apparatus of the railway company is of approved design and pattern and in accordance with good practice for such operations." At Philadelphia a 3 per cent variation above or below is permitted from the normal periodicity of 25 cycles, and also from the normal voltage of 13,200.

The power factor specified at Chicago and Philadelphia is 100 per cent, approximately. At Cleveland the power factor is guaranteed by the railway company at 90 per cent or better, although apparently no specific penalty is imposed if the guaranteed figure be not maintained. But a penalty and bonus clause is added to the paragraph on this subject, which states that if the average monthly power factor varies from 90 per cent in computing the monthly settlement, the figure for demand, as measured in kilowatts, shall be arbitrarily increased or decreased as compared with the actual demand, in inverse proportion to the variation of the load factor from 90 per cent. The treatment of the power factor in the Cleveland contract is also unusual, because the method of measurement is specified. The tangent of the average monthly angle of lag is determined by multiplying by the factor 1,732 the ratio between the sum of and the difference between the readings of two single-phase watt-hour meters installed on the supply circuit. From the tangent of the angle of lag, the cosine of the angle of lag, or power factor, is determined by reference to the standard tables.

The "demand," or the figure from which the demand charge is calculated, is in all three cities established each month from hourly peaks of any three consecutive days of the month which may be selected by the power company. At Cleveland only one hour from each of the three consecutive days is selected, and this must be an even clock hour, as from 5 p. m. to 6 p. m. At Chicago and Philadelphia two hours are selected on each of the three days, one in the morning and one in the evening. The average of these hourly readings is used as the demand for the month. The arrangement works out to the advantage of the railway company, for it hardly ever happens that the heaviest three peaks in any month occur on consecutive days. The Philadelphia and Chicago contracts also have the advantage that they include in the average the figures from both the morning and the evening peaks, and, as is well known, the morning peak is by no means as severe as that in the evening. At Chicago the original contract has recently been modified in some respects, and one of the changes provides that the extra power required for heating cars when the outside air is below a temperature of 15 degrees shall be excluded in determining the maximum demand.

At Cleveland maximum and minimum figures are specified as limits for the demand, namely, 15,500 kilowatts and 10,000 kilowatts, and the minimum demand charge made by the power company is based on the latter figure, whether the power is required or not. In this contract, however, there is another clause which provides that when the demand for power in any month has increased beyond 14,300 kilowatts the minimum which shall be paid for during any succeeding month when the load may be light shall be 70 per cent of the highest demand previously made by the railway company. In other words, the final basis for the minimum demand allows for periods of light traffic a margin of 30 per cent below the heaviest previous monthly demand.

In the Philadelphia and Chicago contracts, however, the minimum guaranteed demand which must be paid for by the railway, whether the power is supplied or not, is equal to the maximum demand which has been established in any previous month. The Philadelphia contract obligates the railway to pay for 15,000 kilowatts, and if during any month the demand, as determined by the previously described method, shall exceed 15,000 kilowatts, this increased demand shall represent for that month, and for every succeeding month until it is exceeded by a subsequent still greater demand, the minimum demand for which the railway is obligated to pay. On November 15, 1913, the railway company agreed to take an additional 5,000 kilowatts, making the arbitary minimum demand equal to 20,000 kilowatts. The permissible normal increase in demand beyond 20,000 kilowatts is not definitely stated in this contract.

At Chicago the provisions for minimum or guaranteed demand are quite similar to those in the Philadelphia contract. The Chicago contract, however, states that the power company shall stand ready to supply an increase of 10 per cent over the arbitrary minimum, which is set at 30,000 kilowatts for the last nine years of the contract. This excess, however, must not be used by the railway for supplying new lines or large numbers of new cars on existing lines.

For large increases in the demand for power, such as would be required for a new substation or for new cars or new lines, all three contracts require written notice in advance from the railway companies. At Chicago and Cleveland a notice of five months is specified for increases up to 4,000 kilowatts, and 10 months' notice is required for any amount greater than this. At Philadelphia a longer time is evidently considered desirable for the installation of new machinery, since six months' notice is required for a 3,000-kilowatt increase and twelve months' notice for more than that. An interval of five months between written notices of increase in demand is required at Philadelphia and Chicago. Ten months is specified at Cleveland.

The demand charge for the original Chicago contract is based on a flat rate of $1.25 per kilowatt per month. This, however, has been reduced in a subsequent modification of the contract so that it now provides for a sliding scale as follows:

DEMAND IN KILOWATTS.	Demand charge per kilowatt.
Up to 30,000 kilowatts	$1.25
Excess over 30,000 kilowatts up to 60,000 kilowatts	1.00
Excess over 60,000 kilowatts up to 90,000 kilowatts	0.91⅔
Excess over 90,000 kilowatts up to 120,000 kilowatts	0.87½
Excess over 120,000 kilowatts	0.83⅓

At Cleveland also the demand charge is based upon a sliding scale. The demand charge for the first 500 kilowatts is $1.475 per kilowatt per month, and for the second 500 kilowatts $1.45 per kilowatt per month. For all service in excess of 1,000 kilowatts the demand charge is $1 per kilowatt per month, and this makes practically a flat rate for the demand charge. At Philadelphia the demand charge is made on a flat rate of $1 per kilowatt per month without any exceptions.

The charges for energy in the original Chicago contract are 0.415 cent per kilowatt hour during the first one and one-half years of the contract, and thereafter 0.4 cent per kilowatt hour. The Philadelphia contract also specifies an energy charge at a flat rate of 0.4 cent per kilowatt hour. In the modification of the Chicago contract a sliding scale is used which begins with a rate of 0.4 cent per kilowatt hour for the first 5,000,000 kilowatt hours consumed. For each successive block of 5,000,000 kilowatt hours, or fraction thereof, consumed in addition up to 40,000,000 kilowatt hours the price for that block, or fraction, is cut 0.005 cent, so that for any monthly consumption in excess of 40,000,000 kilowatt hours the price for the excess is 0.36 cent. Another novel feature in the modified Chicago contract is a provision for an extra charge to be made in case the price of coal of customary heating value exceeds $1.90 per ton, the normal price in Chicago.

This additional charge is obtained in dollars by dividing the total number of kilowatt hours consumed in two years by 1,000 and multiplying the result by the average excess in price over $1.90 per ton, the result being based on a consumption of 2 pounds of coal per kilowatt hour. In case the price shall drop below $1.40 per ton, the power company is to pay an equivalent rebate to the railway.

At Cleveland a sliding scale is used which specifies an energy charge of 0.95 cent for the first 50,000 kilowatt hours used in any month, 0.90 cent for the next 50,000 kilowatt hours, 0.45 cent for the next 400,000 kilowatt hours, and 0.40 cent for the next 1,800,000 kilowatt hours. For any monthly consumption in excess of 2,300,000 kilowatt hours the price for the excess amount is 0.38 cent per kilowatt hour.

At Cleveland and Philadelphia a minimum load factor of 35 per cent is definitely specified, and if this is not maintained, the energy charge will be based upon this instead of the actual energy consumption. At Cleveland the load factor is defined as the "quotient obtained by dividing the kilowatt hours consumed in any month by 720 times the maximum demand for such month," thus permitting a comparatively wide range for the minimum energy charge.

In the Philadelphia contract the 35 per cent load factor is defined as that number of kilowatt hours which will equal 35 per cent of the total number of kilowattt hours which would be consumed in any month if the energy represented by the maximum demand for that month were exerted during every hour of the month. This calculation involves the consideration of the varying number of hours in the month, which, in the Cleveland contract, is approximated by the use of the figure 720, the number of hours in a 30-day month. Otherwise, it would establish the minimum number of kilowatt hours which must be paid for at a practically constant figure, because the maximum demand, upon which the 35 per cent load factor is based, is likely to be fixed by the record load of some preceding month. At Chicago no provision is made for maintaining a minimum load factor with the exception that after the seventh year of the contract the railway is permitted to utilize sources of power other than those of the original contracting power company, but if it does so, the load factor must be maintained at 35 per cent, under penalty of paying for an equivalent number of kilowatt hours whether they are used by the railway or not.

Underground transmission lines are, in all three cases, maintained by the power company, but the substations, including the transformers, are operated and maintained by the railway. At Cleveland and Chicago the power is measured by instruments at the switchboard of the power company, but the transmission loss is guaranteed by the power company to be not more than 5 per cent. At Philadelphia, and also under the new Chicago contract, power is measured at the railway company's high-tension busbars in the substations, and in consequence the power company stands the transmission loss. The measuring instruments in this case are maintained by the power company.

Duplicate high-tension lines or their equivalent are required at Philadelphia, but at Cleveland the interruption of supply is covered by a clause requiring due diligence on the part of the power company in maintaining service and providing a rebate on the demand charge for any interruption in excess of five minutes. Length of transmission lines to new substations is covered at Cleveland only indirectly by the call for a minimum demand of 2,000 kilowatts for each new station built. At Philadelphia, if the length of transmission lines to new substations exceeds the length of existing lines the railway must pay 10 per cent per annum upon the cost of such excess length.

In all cases meters are read at noon on the last day of the month. Their accuracy is required to be within 2 per cent, and they are to be tested each month in the presence of the railway's representative at the expense of the power company. The Cleveland contract, in addition, permits testing on demand, but not more often than biweekly except at expense of the railway. Special tests may be made at any time upon written request. Corrections made in readings on account of errors in meters in excess of 2 per cent are to apply to the previous month only.

At Cleveland and Philadelphia an arbitration board composed of three members is specifically outlined for the purpose of settling questions as to the meaning of the contract. The resale of power is prohibited in every case, and the power companies are not held responsible for nondelivery of power due to causes beyond their control, although the railway companies are to have rebates equivalent to the demand charge during the period of interruption. In the Philadelphia contract a period of 90 days is allowed to the power company before the contract may be canceled, to permit it to effect a remedy of any trouble which is covered by a decision of the arbitration board.

Purchased power in New York state.—The reports furnished by the street railway companies of the state of New York to the public-service commission of the second district furnish some very interesting information in regard to the methods under which they purchase and are supplied with electric energy. Naturally, a great variety in practice is shown. Some of the examples are cited below.

The Niagara power companies have contracts which take such a form that current furnished on the basis of 100 per cent load factor is extraordinarily cheap. The price of $16 per horsepower per annum at that factor amounts to 0.245 cent per kilowatt hour. The companies, however, heavily penalize any variations from an absolutely steady load, although the price for additional power beyond the basic payment would be considered low in almost any other part of the country. In consequence, it is the custom for the railways which use Niagara power to take energy from the producer at 100 per cent load factor, or as near to that as can be obtained in practice. Most of them have steam plants floating on the line to take care of peaks. The contracts of the Niagara power companies generally include the term "firm power." This term applies to the quantity of power which the purchaser agrees to buy, and the purchaser pays for it whether it is used or not. In consequence, this power is used at 100 per cent load factor. Additional firm power, or a normal increase in the demand, is also furnished at 100 per cent load factor. The price of additional firm power does not necessarily agree with that charged for original firm power, for the reason that, opposing the tendency toward a decreased price on account of increased quantity, there may be necessity for considerable additional expense on the part of the power company in providing for the increased demand, such, for instance, as new cables, poles, or connections. Additional kilowatt hours in these contracts are sold on a straight kilowatt-hour rate basis, and the matter of load factor is not taken into consideration. While this charge is often less than 1 cent per kilowatt hour, it appears extremely high when compared with the 0.245 cent per kilowatt hour often used as a basic price for firm power, and in localities fortunate enough to be served by the Niagara companies there is a strong endeavor to avoid such payments.

Following are summaries of certain power contracts in New York state which were reported to be in existence during the year ending June 30, 1912:

Adirondack Lakes Traction Co. had a contract with Fonda, Johnstown & Gloversville Railroad for power, not measured, at $15 a day.

Albany Southern Railroad purchased 4,593,211 kilowatt hours from its own electrical department at 0.67 cent per kilowatt hour.

Babylon Railroad has a contract, dated September 19, 1910, with the Babylon Electric Light Co. to furnish electric energy from July 15, 1910, to the fifteenth of each succeeding month. The consideration is $450 for 15,000 kilowatt hours, 2.5 cents per kilowatt hour for each kilowatt hour in excess of 15,000 and less than 25,000, and 2 cents per kilowatt hour for each kilowatt hour in excess of 25,000, unless the total consumption shall be less than 12,857 kilowatt hours, when the rate is 3½ cents for each kilowatt hour during any one month. During the year ended June 30, 1912, 163,660 kilowatt hours were supplied at 2.9 cents per kilowatt hour. Power is being furnished at $450 per month during the summer season and at $375 per month during the winter season.

Buffalo & Depew Railway has a contract with the Niagara, Lockport & Ontario Power Co., dated January 3, 1910. It expires March 1, 1930, and the consideration is $16 per horsepower per annum and 0.55 cent per kilowatt hour. During the year ended June 30, 1912, 380,000 kilowatt hours were supplied at 0.549 cent per kilowatt hour. In addition to the kilowatt hours, power was purchased as follows: 1,366 horsepower at $16 per horsepower year, for $21,856, plus $261 for excess peaks.

Buffalo & Lake Erie Traction Co. purchased during the year ended June 30, 1912, 8,954,987 kilowatt hours from the Niagara, Lockport & Ontario Power Co., at 0.702 cent per kilowatt hour, and also 1,465,740 kilowatt hours from the International Railway at 1.131 cents per kilowatt hour.

Buffalo & Williamsville Electric Railway had a contract with the Genesee Light & Power Co., Batavia, N. Y., under which the first power was delivered August 2, 1909. The contract expired five years from that date. The consideration was 3.75 cents per car-mile with a minimum monthly rental of $250 based upon a minimum demand of not exceeding 100 kilowatts. The company also has a contract with the Niagara, Lockport & Ontario Power Co., dated March 18, 1910, and expiring 10 years from May 1, 1910. The consideration for each electric horsepower delivered is $16 per year as the service charge and, in addition, 0.55 cent for each kilowatt hour used when the firm power is less than 300 horsepower, 0.5 cent for each kilowatt hour used when the firm power is 300 horsepower or more but less than 500 horsepower, 0.47 cent for each kilowatt hour used when the firm power is 500 horsepower or more but less than 750 horsepower, and 0.44 cent for each kilowatt hour used when the firm power is more than 1,000 horsepower. The service charge is based on the average of the highest daily one-minute peaks.

Catskill Traction Co. has no formal agreement, but power is bought of the Schoharie Light & Power Co. The total number of kilowatt hours supplied during the year was 261,400, the total gross charge being $4,621.28, at an average net price per kilowatt hour of 1.75 cents.

Eastern New York Railroad Co. purchased during the year ended June 30, 1912, 202,675 kilowatt hours from the Adirondack Electric Power Corporation at a price of 1.5 cents per kilowatt hour measured on the alternating-current side.

Elmira, Corning & Waverly Railway purchased from the Elmira Water, Light & Railroad Co. 1,576,514 kilowatt hours at a price of 1.5 cents per kilowatt hour.

Fishkill Electric Railway Co. purchased 358,904 kilowatt hours from the Southern Dutchess Gas & Electric Co. at a price of 3.5 cents per kilowatt hour.

Hornell Traction Co. paid the Hornell Electric Co. in the year ended June 30, 1912, for power for city cars at a rate of $2.35 per car per day, and for the Canisteo cars at the rate of $3.65 per car per day.

Hudson River & Eastern Traction Co. was supplied with 302,880 kilowatt hours by the Northern Westchester Lighting Co., the rate being 2.5 cents per kilowatt hour.

Ithaca Street Railway Co. pays the Remington Salt Co. for such quantities of electricity as it may require at the rate of 1 cent per kilowatt hour for alternating current at the switchboard of the generating station. In addition to this, the railway company pays one-half of the labor cost in the engine room of the power station, amounting to $167 per month.

Lima-Honeoye Light & Railroad Co. purchased from the Livingston Niagara Power Co. 172,172 kilowatt hours at 3.14 cents per kilowatt hour.

New York & Stamford Railway Co. paid the New York, New Haven & Hartford Railroad Co. for 155,740 kilowatt hours at a rate of 1.25 cents per kilowatt hour.

New York Central & Hudson River Railroad Co. paid the Rochester, Syracuse & Eastern Railroad Co. for power at a rate of 2 cents per kilowatt hour, $1,119.50 for 55,975 kilowatt hours.

New York State Railways bought of the Rochester Railway & Light Co. 45,442,298 kilowatt hours at 1.0942 cents per kilowatt hour, amounting to $497,222.50.

Northport Traction Co. has no contracts or agreements, but purchased of the Long Island Railroad 63,546 kilowatt hours at a rate of 5.52 cents per kilowatt hour, amounting to $3,509.61.

Orange County Traction Co. purchased from the Central Hudson Gas & Electric Co. 254,370 kilowatt hours, costing $4,425.12, at a rate of 1.78 cents per kilowatt hour. The company also purchased from the Walkill Power Co. 674,158 kilowatt hours, costing $8,425.85, at a rate of 1.25 cents per kilowatt hour.

Otsego & Herkimer Railroad Co. purchased of the Hartwick Power Co. 3,909,979 kilowatt hours at a rate of 1.67 cents per kilowatt hour, amounting to $65,435.05.

Plattsburgh Traction Co. purchased power from the Plattsburgh Gas & Electric Co. at 1 5 cents per car-mile operated, the kilowatt hours not being measured. The cost for the year was $2,265.04.

Several other similar instances in the state could be cited.

Purchased power for operation of Pennsylvania Railroad suburban lines.—The Pennsylvania Railroad has announced that the contract for the electrical energy for the electrification of its lines between Broad Street Station and Paoli, and also between Broad Street Station and Chestnut Hill, has been made with the Philadelphia Electric Co. The contract is for five years. At the beginning the Pennsylvania Railroad will use about 5,000 horsepower, a minimum of 3,750 kilowatts, with a load factor of 25 per cent, being specified. The energy is to be furnished for the main line to Paoli and any addition or extension thereto, the railroad company reserving the right to call on the Philadelphia Electric Co. for any additional power that may be necessary for its general system from time to time. With the completion of the present work as planned, the Pennsylvania Railroad will have 32 miles of electrified lines in the Philadelphia suburban district. The cost of the energy to the railroad company for the Paoli line for the first year will be about $150,000. The Philadelphia Electric Co. now feeds a load of 35,000 horsepower daily for the Philadelphia Rapid Transit Co.

Power rate for Puget Sound Railway.—The plans for the electrification of the Chicago, Milwaukee & Puget Sound Railway, from Harlowton, Mont., to Avery, Idaho, a distance of 440 miles, include the supply of wholesale power from the Great Falls Power Co., Great Falls, Mont., with plants at Rainbow Falls and Black Eagle Falls, on the Missouri River. The railway company agrees to electrify its line between Harlowton and Deer Lodge, Mont., a distance of 238 miles, before January 1, 1918, and also agrees to buy from the power company electric energy at the rate of 10,000 kilowatts, maximum demand, for the full period of the 99-year agreement, but two years' notice will be given the power company that delivery must commence. The railway company has several options for more power up to a total of 25,000 kilowatts, maximum demand, the agreement as to this additional demand being as follows: Not less than 4,000 kilowatts nor more than 8,000 kilowatts, if called for prior to January 1, 1923; not less than 3,500 kilowatts nor more than 7,000 kilowatts, if called for at any time between January 1, 1918, and January 1, 1928, and if at least 6,300 kilowatts additional has been called for prior to January 1, 1923. Additional energy, when once called for as above, will be supplied for the entire remaining term of the contract. Delivery of energy will be made to not more than five stations between Deer Lodge and Harlowton, at 50,000 volts or 100,000 volts, 3-phase, 60-cycle, alternating current. The railway substations are to contain sufficient synchronous machinery to secure a power factor, leading or lagging, of at least 80 per cent. Twelve months' notice will be given the power company of the location of the delivery points. The power company will also have the right to install regulators in the substations for the operation of synchronous machinery in such manner as to receive any power factor between 80 per cent leading and 80 per cent lagging. The rate for energy will be 5.36 mills per kilowatt hour, subject to a minimum bill, after the first year of service, equivalent to 60 per cent of all the energy contracted for. The power company is also required to pay the Federal Government a tax of 5 mills per 1,000 kilowatt hours for all energy delivered over transmission lines crossing the public domain. This region is mountainous, embracing some very heavy grades, and it is estimated that electrical operation will result in large financial saving.

LINE CONSTRUCTION.

Line-construction features.—The subject of line construction has received increasing attention from street railway companies in recent years, and its treatment at the hands of the committee on power distribution of the American Electric Railway Association takes the shape of voluminous yearly reports which cover all branches of the work. In no department has the trend toward standardization been more strikingly manifested. A great many conditions are involved in the maintenance of overhead-line trolley service with relation to continuity of service; supply from power-transmission lines; joint use of poles; overhead crossings on steam railroad tracks or with other wire systems; nature of poles; use of concrete, lattice, or tubular metal poles; trolley guards; and numerous other features of the service. These could only be dealt with adequately by quoting in full the specifications of the American Electric Railway Association as to such items, constituting a formidable volume of specific data. It will be sufficient here to note some instances of modern practice under which the industry is operated.

Probably the most important feature of all is the safeguarding of lines which connect with outside sources of current supply, for within city limits the familiar methods of central poles, side brackets, and cross suspension seem to have become thoroughly standardized and accepted. One hears very little about them, and there is a notable absence of discussion of them in the technical press. There is a refinement of method in this field, rather than any radical change.

Transmission lines in Georgia.—An excellent example of work in the field of power-transmission service is furnished by the lines for the service of the Georgia Railway & Power Co. of Atlanta, Ga., from the famous Tallulah Falls. The energy from the Tallulah Falls station is transmitted over a steel-tower line from

Tallulah Falls to Atlanta, a distance of 90 miles; from Atlanta to Lindale, a distance of 80 miles; and also from Atlanta to Newnan, a distance of 50 miles. The main line from Atlanta to Tallulah Falls is constructed with six No. 0000 copper conductors and two $\frac{7}{16}$-inch, 7-strand, galvanized-iron ground wires, the latter being mounted on the ends of cross arms at the tops of the towers above the cross arms carrying the main lines. The transmission lines from Atlanta to Lindale and from Atlanta to Newnan are constructed with No. 00 copper, the same general type of construction as on the main line prevailing. The insulators are all of the suspension type, four-disk, two-part insulators being used on the main line from Tallulah Falls to Atlanta, and insulators with five 10-inch disks on the other circuits. A telephone circuit of No. 4 special 30 per cent copper-clad wire is also strung on the towers and insulated by 15,000-volt insulators. The telephone line is continuous from the power house to all of the substations, and at each interval of 4 miles a small telephone booth supplied with a high-voltage switch, which completely isolates the telephone apparatus when not in use, is provided. At the various terminals and at the Boulevard substation in Atlanta there are located special high-frequency or tuned telephone calling circuits for signaling the specific points desired without interfering with the magneto calling systems. The telephone line is protected by the use of horn gaps to ground on the high-voltage side and by a new multicylinder type of oil-filled arrester.

A novel method of transposition is accomplished by having the telephone circuits placed on insulators with pins of different heights. The wires enter the tower in a nearly horizontal plane—one on a high pin and the other on a low pin; that on the high pin crosses diagonally to another high pin on the far side of the tower, and that on the low pin crosses to a low pin, the wires clearing each other by about 5 inches. This method of making transpositions does away with the customary deadening of the line and connecting of opposite wires with a jumper.

The steel transmission towers used on the line are spaced about 17 to each 2 miles. Three standard types, 66 feet, 70 feet, and 80 feet in height, are used, the first for the No. 0000 copper circuits of the main line, the second for the No. 00 circuits of the lines running to Newnan and to Lindale, and the third to carry the high-tension and low-tension circuits around the outer zone of the city of Atlanta. The bases of the towers, which are square, have side dimensions of 16 feet, 18.5 feet, and 20 feet, respectively.

The 110,000-volt wires are spaced on 9-foot centers suspended vertically, one 3-wire circuit on each side of the structure. The towers on the main line weigh 5,554 pounds, those on the branch lines weigh 4,721 pounds, and the special towers used around the city of Atlanta weigh approximately 8,000 pounds. The cross arms are of standard channel-iron section and the tower legs are of angle-iron section. Special U-bolts secure the suspension insulators to the cross arms. The footings are made by extending the tower-corner angles into the ground to a depth of about 7 feet, and footing angles are bolted to the bottom ends. In addition to the standard towers, special angle towers are used for line angles above 10°. The latter towers are of the same design as the standard tower, but of heavier section, and have eccentric cross arms to take care of clearances for angle location. These strain towers on the main lines weigh 6,880 pounds and those on the branch lines weigh 6,680 pounds. In a number of places towers 105 feet high are used.

The towers, of which there are, all told, 1,754, were tested for vertical, horizontal, and torsional loads before shipment. The towers for the main lines were designed for a longitudinal pull of 4,300 pounds at right angles to the end of any one cross arm, a vertical load of 1,500 pounds at the end of any or all cross arms, a load of 1,500 pounds pulling at the top of the tower in any direction, and a load of 10,000 pounds pulling at right angles to the line or parallel to the cross arms; and at the same time a pull of 8,000 pounds vertically to the line or at right angles to the cross arms—that is, 4,000 pounds at each end of one single cross arm or at each of any two ends of any two cross arms. The towers for the branch lines were designed for a longitudinal pull of 3,000 pounds, a vertical load of 1,200 pounds, a load of 1,200 pounds pulling in any direction at the top of the tower, a load of 8,000 pounds pulling at right angles to the line, and at the same time a pull of 5,000 pounds longitudinally to the line or at right angles to the cross arms. The cross arms are proportioned for a combined load of a longitudinal pull of 3,000 pounds, a vertical load of 1,200 pounds, and a horizontal thrust of 1,000 pounds at the ends. The material used in the construction is all thoroughly galvanized, and sherardized bolts were employed in assembling the various parts.

Transmission system in Missouri.—One of the larger interurban systems of 1912–13 is that of the Kansas City, Clay County & St. Joseph Railway, which is a good example of the modern method of connecting cities electrically by trolley in face of steam competition. There are six steam roads operating for freight and passenger business between the terminals named, and a seventh competitor would seem wholly superfluous, but various advantages pertain to the electric method for high-speed, short-route purposes. Current is received from outside sources at 33,000 volts, 25 cycles, being converted to 1,200-volt direct current at five substations along the two divisions of the line. One pole line is used to carry the trolley wire and 3-phase transmission line, one telephone circuit, and the feeder cable, space being allowed on the cross arms for signal wires. The plan is such that the road may ultimately be operated at 1,500 volts direct current, with 1,200 volts direct current for initial operation. The design is also initially for single track, permanently located on the right of way as one of the tracks of a double-track road.

In general, five-point catenary bracket construction is used, span construction being employed only on long overhead viaducts and bridges and for short distances in the cities. Bracket construction is also used on the 15 sidings on the St. Joseph division and the 8 sidings on the Excelsior Springs division, a line of poles being set on the outside of the siding and opposite the main line of poles. With this design, in case the line is double-tracked the siding poles may be used as main-line poles without change.

The pole spacing is 150 feet on tangent line and less on curves, the distance depending upon the degree of curvature. The accompanying table gives approximately the spacing used on curves, also span and pull-off spacing.

TABLE SHOWING POLE SPACING, ETC., ON DIFFERENT DEGREES OF CURVES.

Brackets.	Degree of curve.	Pole spacing.	HANGERS.		Sag.
			Straight line.	Pull-off.	
Feet.		*Feet.*	*Number.*	*Number.*	*Inches.*
9	Tangent to 1°	150	5	....	16
12	1° to 2¾°	150	4	1	16
12	2¾° to 3¼°	135	4	1	13
12	3¼° to 4°	120	4	1	10
12	4° to 5½°	105	4	1	8
12	5½° to 7½°	90	2	1	6
12	7½° to 10°	75	2	1	4
12	10° to 17°	60	....	2	2½
12	17° to 80-foot radius	45	....	3	....

All sags are calculated to a temperature of 60° F. The sags above given are from the center of the messenger to the center of the trolley, equal to 22 inches at the bracket arm.

All poles are Michigan white cedar, those carrying transmission lines being 40 feet in length and those without transmission lines 35 feet in length. All poles have a diameter of 8 inches at the top to comply with the Northwestern Cedar Men's Association standard specifications for electric poles. As a rule, the poles were framed before being set, and the pins and insulators placed on the cross arms. In special instances, where the wires pass over foreign transmission and telephone lines, poles having a length as great as 60 feet are used. The following table gives the pole settings for different lengths of poles:

35-foot poles in the ground 6 feet deep.
40-foot poles in the ground 6 feet deep.
45-foot poles in the ground 6 feet 6 inches deep.
50-foot poles in the ground 7 feet deep.
55-foot poles in the ground 7 feet 6 inches deep.
60-foot poles in the ground 8 feet deep.

On curves all poles are keyed with stone or timber, and in soft ground are set in concrete at points of special strain. Poles on bracket construction are set with their faces a distance of 7 feet 6 inches from the center line of the track, and on straight line they are set with a rake of 8 feet from the track. On span construction through towns, and at other places where such procedure was necessary, the main pole or poles are set with a rake of 2 feet and the 35-foot poles opposite with a rake of 4 feet. Where guying was necessary, ⅜-inch, 7-strand, galvanized-steel wire having a tensile strength of 5,000 pounds was used, the pole being protected by galvanized-iron bands where the guy wire passes around it. Wood-strain insulators are cut into all guy wires at a distance of 8 feet from the pole, and the guys are anchored to ⅝-inch by 6-foot anchor rods, passed through 6-inch by 8-inch by 8-foot ties, buried 5 feet deep. All guying was done before any strain was brought on the poles by the erection of any high-tension trolley or feeder wires.

The cross arms are of Washington fir, with dimensions as follows: For the 33,000-volt, high-tension line, 5 inches by 6 inches by 10 feet, four pin; feeder arm, 3½ inches by 4½ inches by 4 feet, three pin; telephone cross arm, 3½ inches by 4½ inches by 8 feet, eight pin. Spaces have been allowed on the telephone and feeder cross arms for the installation of signal wires. The high-tension cross arm is placed at the top of the pole and is braced with 1½-inch by 1½-inch by 3/16-inch angle brace having a spread of 5 feet. The feeder arm is placed second from the top, immediately above the bracket arm, and the telephone arm just below the bracket arm. On curves of 2 degrees and greater, iron pins having a ¾-inch by 7-inch shank and a 4¾-inch curved base, to fit 5-inch by 6-inch arms and extending 7½ inches above the high-tension cross arms, are used. For high-tension lines along tangent track locust pins 13 inches over all and having a 1¾-inch by 6-inch shank, to fit 33,000-volt insulators, are installed. For the direct-current 1,200-volt feeders the company uses 1½-inch by 4½-inch shank, locust pins, 9 inches over all, and for the telephone line 1½-inch by 4½-inch shank, locust pins, 9 inches over all. For telephone transposition, 1½-inch by 4½-inch shank, locust pins, 10 inches over all, are used.

All insulators on the St. Joseph division are brown porcelain, having a wet flash-over test of 68,000 volts and a dry flash-over test of 90,000 volts. The high-tension line on the Excelsior Springs division is carried on porcelain insulators having a wet flash-over test of 70,000 volts and a dry flash-over test of 133,000 volts. All 1,200-volt feeder insulators are designed for a working voltage of 6,600.

The 9-foot bracket arms are 2½-inch by 2¼-inch by ¼-inch T-sections, with ⅝-inch tension rods. All brackets are black japanned. For tangent steadies on inside curves the bracket arms are 12-foot long, 2¼-inch by 2¼-inch by 5/16-inch T-sections with ⅝-inch tension rods. These also are black japanned. The messenger insulators are designed for a test voltage of 20,000 volts.

On span-wire construction, ⅜-inch, 7-strand galvanized-steel cable having a tensile strength of 5,000 pounds is used. This is attached to the poles with

$\frac{5}{8}$-inch by 14-inch galvanized eyebolts. These eyebolts are placed at such a height as to allow for a dip in the span wire of 1 foot in 10 feet, with the eyebolt run out its full length. Wood strains are cut into the span wire 8 feet from the trolley on either side and into the pull-offs and bridle guides. The catenary cable is supported at the center of the span by Westinghouse cross-stand messenger hangers.

The catenary construction is of the single-messenger type, the sag at the center being approximately 16 inches. The messenger is $\frac{7}{16}$-inch steel strand, having a tensile strength of 9,000 pounds and an elastic limit of 5,300 pounds. Five-point suspension, with flexible catenary hangers and curve pull-offs, is used.

The trolley wire used is No. 0000 B. & S. gauge, hard-drawn standard grooved copper having a tensile strength of 46,500 pounds per square inch. The height of the trolley wire is 19 feet above the heads of the rails.

The feeder wire is 500,000-circular-mil bare-stranded copper cable, composed of 37 strands, each having a diameter of 116.2 B. & S. gauge, concentric type. This cable is strung the entire length of both the Excelsior Springs and St. Joseph divisions. It is tied to the insulators with No. 6 B. & S. soft-drawn copper wire and is rope-spliced and soldered. This feeder was erected before the bracket arms were put in position, and is placed on the track side of the pole.

The trolley and messenger is sectioned at four points, one being on each division to insulate the 1,200-volt railway current from the 600-volt current of the Union Depot Bridge & Terminal Railway, one at the substation on the Excelsior Springs division, and one at substation B on the St. Joseph division. Twelve-hundred-volt section insulators are used. The feeder is tapped into the trolley approximately three times per mile. The taps are No. 0 B. & S. copper wire, soldered to the feeder and run through two feed-tap porcelain insulators and fastened to the feed-tap trolley feeder.

Twelve-hundred-volt arresters are used for the protection from lightning of the feeder and trolley wires. These arresters are located about five to the mile and are so spaced as to bring an arrester on each pole where a feed tap is located. These arresters are placed about 17 feet above the top of the rail and each is connected to the feeder wire by means of a No. 6 B. & S. copper wire which is soldered to the No. 0 B. & S. copper wire and is stapled to the pole with galvanized fence staples. The end is soldered to the brass cap of a $\frac{3}{4}$-inch by 7-foot galvanized-iron pipe having a driving point placed at one end and the brass cap at the other end. This pipe is driven directly underneath the lightning arrester to a depth of 6 feet, leaving 1 foot above the ground.

The high-tension, 33,000-volt, 3-phase, 25-cycle transmission line is carried from the Metropolitan power house in Kansas City to the junction transformer station by three 300,000-circular-mil bare-stranded feeder cables. From the transformer to substation A on the St. Joseph division, a distance of about 12 miles, three No. 2 B. & S. medium hard-drawn bare copper wires are used. These are supported on insulators and pins as stated above and tied in with No. 6 soft-drawn B. & S. copper tie wire. From substation A to substation B, a distance of about 26 miles, and also from the transformer station to substation C on the Excelsior Springs division, three No. 4 B. & S. medium hard-drawn bare copper wires are strung.

For the protection of the high-tension lines a No. 6 B. W. G. galvanized-steel wire is strung over the tops of all high-tension poles. It is placed at a height of 22 inches above the top of the pole and 3 feet 6 inches above the top of the high-tension cross arm, and is fastened to a porcelain knob, which in turn is bolted to a 2-inch by 2-inch by $\frac{3}{16}$-inch by 3-foot 6-inch angle iron. This ground wire is grounded approximately five times to the mile by means of No. 8 B. W. G. galvanized-steel wire, which extends down the track side of the pole and is fastened at intervals of 5 feet with galvanized-iron fence staples. This wire is attached to the ground wire by wrapping and soldering and is grounded at the base of the pole to a $\frac{3}{4}$-inch by 7-foot galvanized pipe, having a driving point and brass cap, and driven into the ground at the base of the hole.

The telephone circuit consists of two No. 10 B. & S. copper wires. This line is transposed every 1,000 feet, the transposition being made on one transposition insulator. Telephone jack boxes are placed every mile and at all sidings for the entire length of each division.

Pacific Electric Railway catenary construction.—During 1911 to 1913 the Pacific Electric Railway of Los Angeles, Cal., installed over 50 miles of catenary construction on about 40 miles of route, with the intention of making this method or type its standard on interurban lines. The heavy service conducted by the company makes a straight-running working conductor, such as is furnished by a catenary overhead construction, extremely desirable, as will be seen from the statement that the trains of three or more cars, each car weighing over 80,000 pounds, are often run at speeds on the interurban stretches of 60 miles per hour or more, and that long freight trains are operated by 60-ton locomotives. The amperage which is collected from the wire at high speeds is consequently very large, and it would probably have been impossible to collect the requisite amount of current from the overhead system if the company had not for a long time been using a trolley with a pneumatic base, by means of which a pressure of about 30 pounds is put upon the wire at the trolley wheel. The problem of overhead collection has thus been greatly reduced.

In the standard pole and bracket construction used in the latest catenary work of the company, one system includes a pole designed to carry also a single transmission line; the other, a double transmission line. In the former case the three wires are carried in the same horizontal plane, an arrangement which differs from the usual triangular plan, but is considered by the company better where the length of transmission is not too great, so that there will not be any serious unbalancing effect from induction. The three transmission wires are carried on a single cross arm so that they are easily accessible to the linemen. In the second arrangement the three transmission wires are in a vertical plane, and as the cross arms are 8 feet in length this arrangement also permits easy access to the wires by the linemen. In tangent catenary construction the poles are spaced 150 feet apart, this distance being shortened on curves to 60 feet, even for a 1-degree curve. The transition from 150 feet to 60 feet is made gradually.

A variety of types of hangers and insulators has been used in the catenary construction already installed, including the Southern Pacific type of hanger with round loop at the top and the commercial type of strap hanger with an extended flap loop. The hangers are spaced 15 feet apart. The company has found it necessary to use tie spans to the trolley wire at occasional intervals on tangents to hold it in position. At present these spans are being used about every 300 feet. Otherwise the wire would cant, especially under heavy side-wind pressure and when pressed up by the trolley pole. The company is constructing all of its catenary line for 1,200 volts, because it has planned to change gradually to this high voltage on the interurban sections. It is also planning gradually to change from the ordinary overhead construction to the catenary construction.

In all of its overhead construction the company treats the bases of its poles to prevent decay, the treatment being applied to the portion of the pole under the ground and for a distance of 1 foot or 2 feet above the ground. This corresponds to about one-seventh of the length of the pole. The process consists of charring the butts or portions treated over a fire made of shavings, and, while the charred wood is still hot, pouring crude oil over it. In this way charcoal forms readily, and good penetration for the preservative material is secured. This process is applied in the pole yards and costs about 50 cents per pole for material and labor. The oil used is the ordinary crude oil, which costs in Los Angeles about 75 cents a barrel. After the pole is erected it is painted.

Statistics of wooden poles.—Statistics of the number of wooden poles purchased in the United States in 1911 by steam and electric railroads, electric light and power companies, and telephone and telegraph companies are presented in a bulletin issued by the Bureau of the Census. The figures include the pole purchases of practically all of the telephone and telegraph, electric railroad, electric light and power, and steam railroad companies, and accordingly reflect very closely the actual drain upon the pole timber forests of this country. The bulletin was prepared under the supervision of W. M. Steuart, chief statistician for manufactures.

In 1911 the total purchases of poles in the United States amounted to 3,418,020 sticks of timber; of these, 2,402,724, or 70.3 per cent, were purchased by the telephone and telegraph companies; 787,649, or 23 per cent, by the electric railroad and electric light and power companies; and 227,647, or 6.7 per cent, by the steam railroads. The total number of poles purchased represents a decrease of 452,674 as compared with 1910, and of 320,720, as compared with 1909, but it exceeds the totals for 1908 and 1907 by 168,886 and 134,752, respectively. The decrease in the purchases of 1911, as compared with 1910, was confined to telephone and telegraph companies and steam railroads, while substantial increases in purchases were reported by the electric railroad and electric light and power companies.

Five kinds of wood—cedar, chestnut, oak, pine, and cypress—supplied over 90 per cent of the pole requirements of the United States during each of the five years 1907–1911. Cedar, which has long been the preferred wood for pole purposes, supplied 61.4 per cent of the total number reported in 1911. Purchases of chestnut increased substantially from 1908 to 1911, amounting in the latter year to 177,440 more than in 1908. The number of oak poles used increased rapidly from 1907 to 1910, but decreased greatly in 1911, in which year the number reported was more than 65,000 below the figure for 1910. The use of pine has increased but little since 1907. The demand upon cypress has fallen off slowly year by year, the number of cypress poles purchased in 1911 being only about three-fourths as great as the number purchased in 1907. This falling off is due to the high price of cypress lumber and to the fact that this timber is found generally in sizes too large for poles.

The preferred species of wooden poles have the general physical qualifications of durability in the soil, strength, lightness, straightness, a surface which will take climbing irons readily, and comparatively slight taper. The various species of cedar combine these qualities in high degree. Cedar poles are cut principally from the white cedar of the Lake states, the red cedar of the Northwest, and the southern white cedar of North Carolina, Virginia, and New Jersey. Chestnut is cut principally in the Atlantic Coast states from Georgia to New Hampshire. Oak, a very widely distributed species, is cut for poles chiefly in the hardwood states of the Ohio and Mississippi Valleys. Most of the pine reported is that commonly known as southern yellow pine and includes several species—long-leaf pine, short-leaf pine, loblolly pine, and some others. Of these, the most durable is the long-leaf pine, while the loblolly pine gives very brief service unless it is treated with a preservative. In the West another species—western yellow pine—is reported, which also requires preservative treatment.

The woods used for poles in the United States are chiefly those which are naturally very durable in contact with the soil. The life of timber under this condition varies considerably according to the species, to differences in the wood of the same species, to the character of the soil, and to climatic conditions. Cedar, chestnut, cypress, juniper, and redwood usually last from 10 to 15 years, while white oak has an average life of somewhat less than 10 years.

The resistance of the poles to decay can be considerably increased by the use of preservatives. Wood preservation is now on a firm footing in the United States, but the advantages which this practice affords are by no means fully utilized by the pole consumers. Preservatives not only add from 3 to 15 or more years to the service of the woods now commonly used for poles, but also make it possible to use cheaper woods which in their natural condition lack durability in the soil, although possessing all the other qualities necessary in pole timber. The durability of woods which ordinarily last but a few years can thus be increased to more than double the normal life of cedar.

The principal preservatives used for treating poles are those classified as refined coal-tar oils. Under this heading are included creosote oil and various proprietary preservatives. Creosote oil was used in treating 159,321 poles, of which 50,021 were cedar and 83,035 yellow pine. The cost of treating poles varies according to the wood treated, the kind of preservative and quantity used, and the process employed, but it is only in rare instances that the adoption of a pole-treating policy is not economical. During 1911, 656,504 poles were reported as having had some kind of preservative treatment. This number exceeded the total for 1907 by 260,305, that for 1908 by 312,116, and that for 1909 by 79,873, but was less by 168,169 than the number reported as having been treated in 1910.

The following statement shows, by varieties of wood, the number of poles purchased in each year from 1907 to 1911, inclusive:

KIND OF WOOD.	1911	1910	1909	1908	1907
Total	3,418,020	3,870,694	3.738,740	3,249,154	3,283,268
Cedar	2,100,144	2,431,567	2,439.825	2,200,139	2,109,477
Chestnut	693,489	677,517	608,066	516,049	630,282
Oak	199,590	265,290	236,842	160,702	76,450
Pine	161,690	184.677	179,586	116,749	155,960
Cypress	72,995	75,459	77,677	90,579	100,368
Juniper	27,847	20,042	43,581	42,367	38,925
Redwood	26,887	30,421	23,145	13,061	31,469
Douglas fir	24,833	56,732	24,877	19,542	15,919
Tamarack	23,543	30,964	29,889	24,123	13,884
Osage orange	21,101	23,221	21,491	18,109	5,962
Spruce	10,166	22,929	11,423	8,088	10,646
Locust	8,477	9,030	10,463	10,224	4,672
All other	47,258	42,845	31,875	29,422	89,254

Employment of concrete poles.—The last few years have seen a marked increase in the use of concrete poles and in the attention given to them by street railway managers as a substitute for both wooden and metal poles. An example is furnished by the New York State Railways, which, during 1910, 1911, and 1912, utilized these poles on a large scale and established a plant for their production with a capacity of 10 to 15 poles per day. These poles are cast in timber molds of the usual type. The specification as to material is as follows:

> Before casting poles, oil form inside with a mixture of one part black oil and one part gasoline. This oiling to be done immediately before casting pole.
>
> The concrete mixture to be formed from one part cement, two parts sand, and two parts stone, measurement to be made by volume.
>
> All stone used to be clean and free from loam or dirt. Thoroughly wet the stone in the pile before mixing.
>
> Sand to be free from loam or dirt. Place the proper amount of sand on the mixing board and spread out to a thickness of 4 inches. On this sand place the cement and turn both three times, after which apply the water and turn so that the mass is entirely wet. Spread out this mortar again in a 4-inch layer and dump the stone in another layer on top. Turn the mortar and stone until mortar and stone are thoroughly intermixed. The concrete mixture must not be left on the board long enough to require retempering, but should be placed in the forms at once.
>
> In placing the reinforcing rods great care must be used properly to locate the same and maintain in the proper position.
>
> The time of removing of side forms and moving of pole to storage will vary with the weather, but in no case shall a pole be lifted until 96 hours have elapsed after casting. After removal from the forms the pole shall be painted with a mixture of one part cement and one part sand, the pole being wet before the application of this paint.
>
> Remember that a crack formed in a pole by handling too green can not be healed.
>
> In the storage and shipping of poles 2-inch cleats must be placed between the separate horizontal layers of poles to allow attachment of clamps for handling.

Four standard types of poles are made: One with 7-inch top, 30 feet long, being the standard trolley pole for city construction, either bracket or span; one with 7-inch top, 35 feet long, for interurban trolley lines; one with 8-inch top, 30 feet long, for heavy city service; and one with 8-inch top, 45 feet long, for feeder lines. The standard 30-foot pole weighs approximately 3,200 pounds and costs complete, including all material, labor, and maintenance charges, $12.03 at the yard. This pole is designed to take the place of the steel tubular pole costing about $35.

The standard 7-inch, 30-foot pole has reinforcing as follows: Twisted steel rods placed about 1 inch from the surface—four $\frac{5}{8}$ inch by 29 feet, four $\frac{1}{2}$ inch by 23 feet, four $\frac{1}{2}$ inch by 16 feet, and four $\frac{1}{2}$ inch by 8 feet. The poles with 8-inch tops have the same arrangement of rods, all $\frac{5}{8}$ inch instead of $\frac{1}{2}$ inch. The longer poles have the rods lengthened at the top ends. Altogether the New York State Railways, Utica-Syracuse lines, had some 1,400 of these reinforced-concrete poles in use at the end of 1913 on their various city and suburban lines, and tests made as late as March 12, 1914, showed that the standard types and methods of construction needed no change to give greater strength of permanence.

Concrete-pole tests.—Some interesting tests were reported on concrete poles from Oklahoma City, Okla., and Nashville, Tenn., early in 1914, in regard to solid and reinforced poles and the best placing of reinforcement. Six poles each were tested by the Oklahoma Gas & Electric Co. at Oklahoma City, and the Nashville Railway & Light Co. at Nashville. The concrete for all poles was in the proportions 1:2:3½, and high-carbon square cold-twisted steel bars of 50,000 pounds per square inch elastic limit were used for reinforcing. The rods were bent to insure good bonding. The poles were molded in wooden forms by men experienced in concrete work but not especially trained for pole making, so as to duplicate field conditions. The hollow poles were made with sectional tapered sheet-iron cones.

At Oklahoma City the pull was applied by means of a cable fastened to the pole 6 inches below the top and passing through a block attached to a neighboring gas-tank frame. A coal car was attached to the free end of the cable and loaded with sacks of sand. At the ground line the poles butted against a heavy, rounded-end timber braced against the bank, with another timber, renewed for each test, braced against the butt. At Nashville a cable was attached 1 foot from the top of the pole and passed through a block at the top of a guyed mast. The pull was applied by a hoisting crab and measured by means of a pair of dynamometers. Here the poles were braced at the ground line and concrete footings were placed around the butts. Deflections were measured by means of a rule at Oklahoma City and by rule and plumb bob at Nashville. Poles were tested to destruction in all cases.

The general conclusion was that hollow poles are not successful in resisting shearing forces from the ground line down, as all showed shearing failure in this region. After failure the tendency of the concrete on the compression side was to slide by that on the tension side, causing a shearing action in the side walls. Inasmuch as hollow poles are more expensive than solid ones and are more difficult to make, and as they are not much lighter for equal strength, their use is not advised. Poles having few bars with some butt reinforcement were shown to be preferable.

At Nashville the tests showed that a safety factor of 2 is obtained when 1,200 pounds per square inch unit stress is allowed for 1 : 2 : 3½ concrete and 30,000 pounds per square inch for high-carbon steel. The average calculated breaking load (straight-line formula used) for four hollow poles was 2,375 pounds, and the actual breaking load was 1,557 pounds applied 6 inches from the top. Five of the solid poles had calculated average breaking loads of 3,500 pounds, while the actual breaking load was 3,610 pounds.

Trolley brackets on buildings.—One of the noticeable differences in practice hitherto between trolley lines in American city streets and those of the Old World has been the attachment of trolley span wires by plaques or brackets to buildings in European cities, thus dispensing entirely with poles. One of the leading reasons for this difference has been that in Europe the streets through which many of the trolley lines run are very narrow, permitting only one track and affording no foothold for poles. In America the average streets are much wider, and poles can be planted without any real interference with the travel of pedestrians or vehicles. There is also understood to be an objection in America on the part of fire insurance companies to the plan of building attachment. The statistics of the relative inflammability of European and American buildings would appear to warrant this objection, but it is obvious that better methods of installing and insulating lines would overcome it. During the period 1907–1912 there was a marked tendency in some places to clear the streets of poles and to try out the European method. Two instances may be cited. Under the direction of the board of public safety of Fort Wayne, Ind., a movement has been in progress for some time to remove all unnecessary poles and wires from important streets in the business district, and this is working out in a very satisfactory way both to the property owners and to the Fort Wayne & Northern Indiana Traction Co., which operates the local street railway system. Several years ago the board of public safety made arrangements with the owners of property on Calhoun Street, the principal business thoroughfare, by which the railway company was granted easements to attach its span wires to buildings, thus doing away with the necessity for poles for span wires. Rights were also secured for running feeder wires in some instances underground and in some cases down alleys. As a result, span wires were attached to buildings and poles taken down for a distance of a mile on Calhoun Street, greatly improving the appearance of the street. As a matter of protection to the company, papers were signed by the property owners relieving the company from any liability for possible damage to buildings as the result of strain imposed by span wires. The company was put to no expense for this innovation except the expense of making the change. These span wires were attached to the buildings by means of expansion corrugated iron sleeves, which are embedded in the walls to a depth of about 6 or 8 inches.

The other example is that of the Tri-City Railway of Davenport, Iowa. To eliminate pole construction in front of retail stores, the company has developed a method of attaching span wires to the faces of the buildings. This plan is followed generally where the owner of the building requests that it shall be done. The hole in which the eyebolt is inserted is drilled in the wall of the building with a 2-inch pipe drill at an angle of about 96 degrees and to a depth of from 10 inches to 12 inches, according to the length of the eyebolt. A fire-clay mold is then used, placed so as to hold the eyebolt in the center of the hole and to prevent the melted sulphur which is poured into the hole from running down the side of the wall. After the sulphur has cooled the mold is removed, and the sulphur, which is made flush with the surface of the wall, is then painted. Eyebolts are placed in the columns of brick walls in the same way.

Combination trolley and lighting poles.—Another effort toward the diminution of the number of poles on the streets is seen in the various efforts made to carry street lights on the trolley lines. An excellent illustration is afforded by Niagara Falls, N. Y. The International Railway, of Buffalo, N. Y., recently made an installation of combination lighting and trolley poles on the main street of the city of Niagara Falls under somewhat unusual circumstances. The poles, which were purchased by the city, are provided with slots below the ground line so that if desired in the future the feeders now carried upon them may be placed in conduit below sidewalk level. The material used in the pole construction is 7-inch, 6-inch, and 5-inch standard-weight tubing. The poles were installed on Falls Street in accordance with a plan for lighting which had been under consideration in Niagara Falls for many years and which was crystallized by a comparatively recent offer of the Hydraulic Power Co. to furnish free electric current for the lighting system. Early last June the city asked the president of the International Railway Co. if the trolley poles could not be removed from the street in furtherance of the plan. He consented not only to remove the trolley poles but to place the new poles for the city and to transfer the trolley wires and feeders to them without charge. The work of installation was begun in August, 1913, and was completed inside of three months.

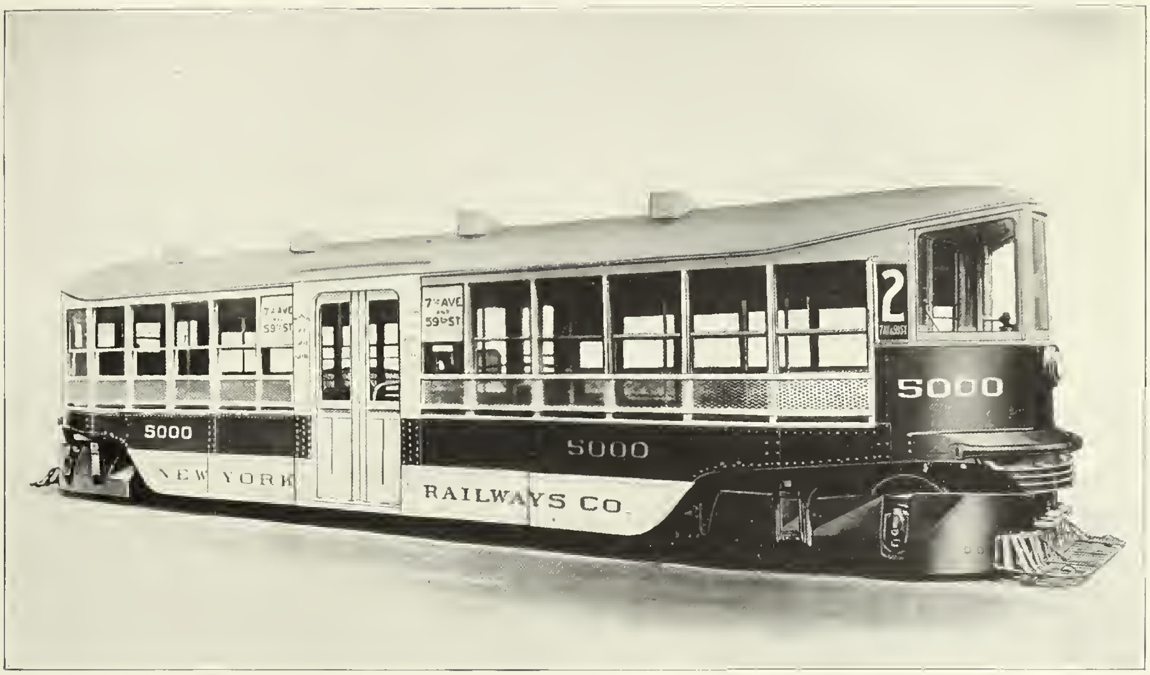
The installation consists of 112 poles, each of which is equipped with a double bracket for supporting a pair of inverted arc lamps of about 800 candlepower each. The poles are spaced at 70-foot intervals, thus giving one of the best street-illuminating systems in the country.

ADVANCES AND CHANGES IN STREET CARS.

No more startling changes in the street railway industry have been shown in years than those in its cars. In the effort to deal with problems of congestion, low rates of fare, public convenience in entering and leaving cars, the full collection of fares, and safety in operation, an extraordinary number of new types have been evolved, each with its special merits, but many of which must undoubtedly disappear from service. The year 1912 was particularly marked by an outburst of originality in this respect, and probably no previous period in street railway history showed so many innovations. Some of these will be noted. The modern stimulus in car design for city service may be said to have begun with the successful demonstration of the pay-as-you-enter car, which originated in Montreal and was shown first in the United States at the Columbus convention of the American Electric Railway Association in 1906. The prepayment plan may now be considered as a permanent feature of city car design. The developments in 1912 were in the extension of this principle to center entrances, with an increase in accessibility to the car, in greater attention to safety features, and in renewed use of one-man cars. Early in 1912 came first the New York "stepless car" with a body hanging near the ground between the trucks, and then the low center-entrance cars of Brooklyn and Washington and the center-entrance, end-exit car of San Diego. These were accompanied by the "low-floor" car of Pittsburgh, in which 24-inch wheels and small motors eliminated one step and reduced the weight to an unprecedented figure. As soon as the success of the low-level cars of New York and Pittsburgh was assured, the trial of double-deck cars based on these designs became almost obvious, and during 1913 cars of this type were placed upon the street almost simultaneously in the two cities. In the meantime, also, the "near-side" principle, developed during 1911, had been applied to one-man cars, thus supplying a need for light-traffic service which had existed, but had been neglected, since the bobtail horse car disappeared. During 1912 also there was under construction and trial the most extraordinary development of all, the "articulated" car of Boston, consisting of two old single-truck cars set end to end and flexibly connected by a low-hanging vestibule with center side doors. Last among the radical designs of the year came the storage-battery "stepless" type, a four-wheeled car without a truck frame and of extremely light weight.

With one exception, all of the center-entrance cars were developed primarily to provide easier access for passengers by a reduction in step heights, with the exceedingly important indirect benefit of decreasing the time of passenger movement, thus permitting faster schedules. Most of the cars mentioned have demonstrated their obvious advantages, namely, increased seating capacity, greater accessibility to all seats, and increased safety of operation.

The articulated car is primarily adapted to the rebuilding of old equipment, and provides an answer to the question as to what disposition can be made of old rolling stock rendered obsolete by the introduction of the new types. The double-deck designs of New York and Pittsburgh also have not apparently arrived at the stage where their merit insures a general adoption. Climate comes in to some extent in determining their field of use. The Pittsburgh car, however, has been reported to be a thorough success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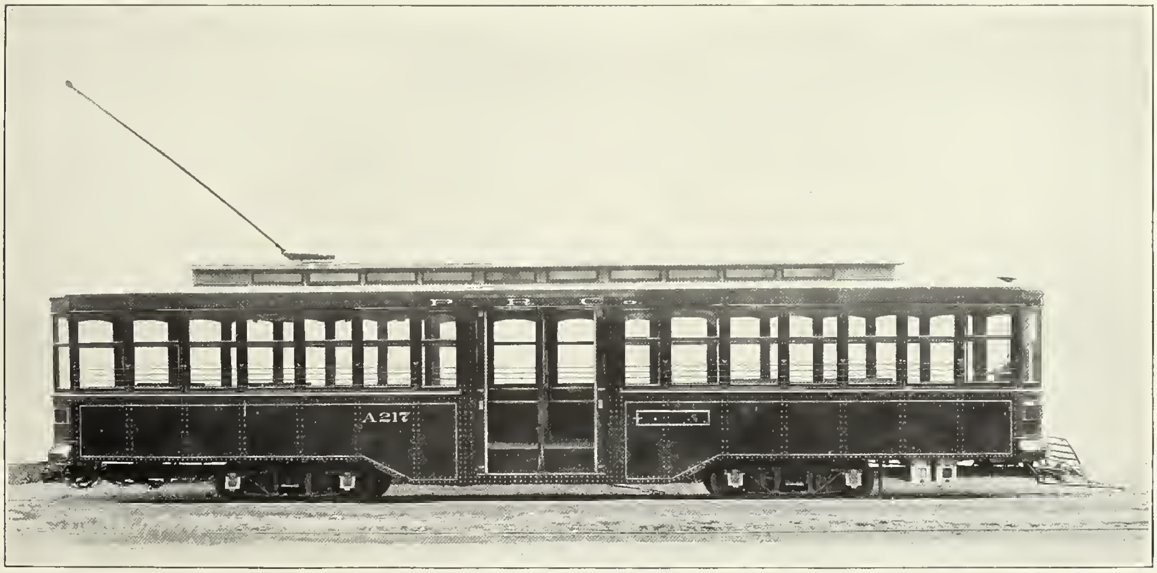
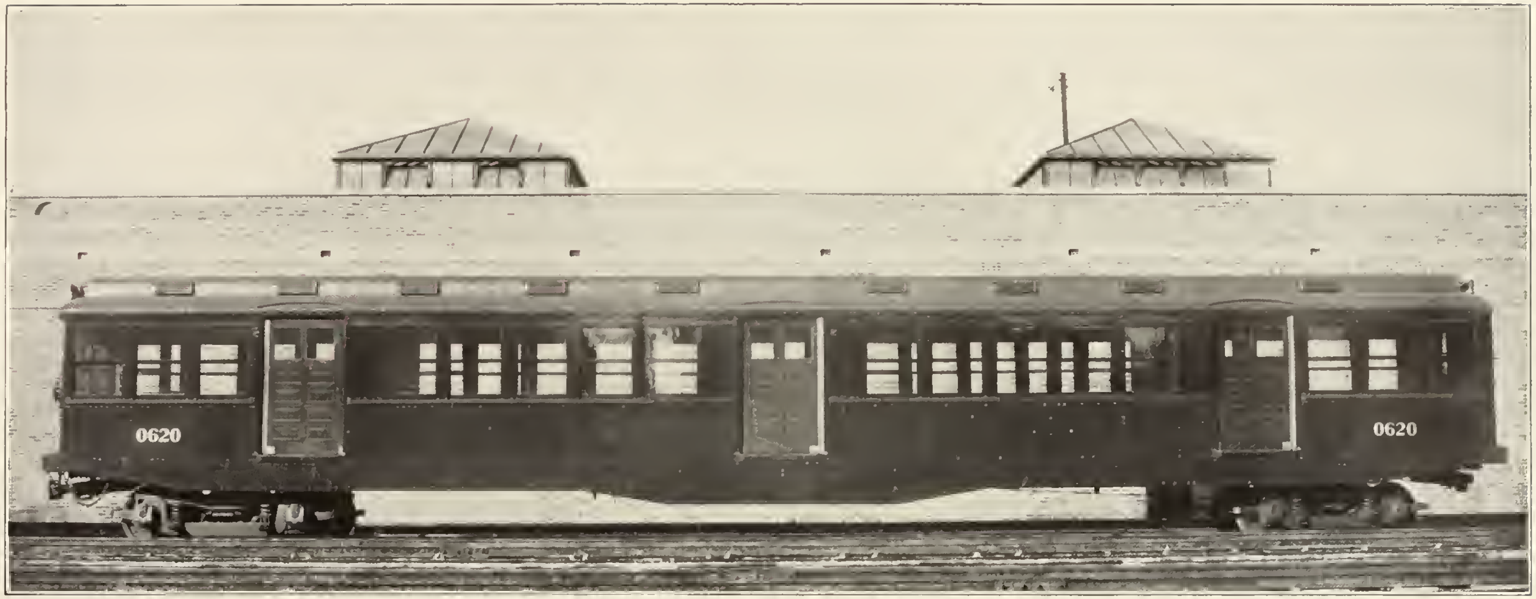
NEW YORK
RAILWAYS CO.

CENTER-ENTRANCE, STEPLESS CAR, NEW YORK RAILWAYS CO.

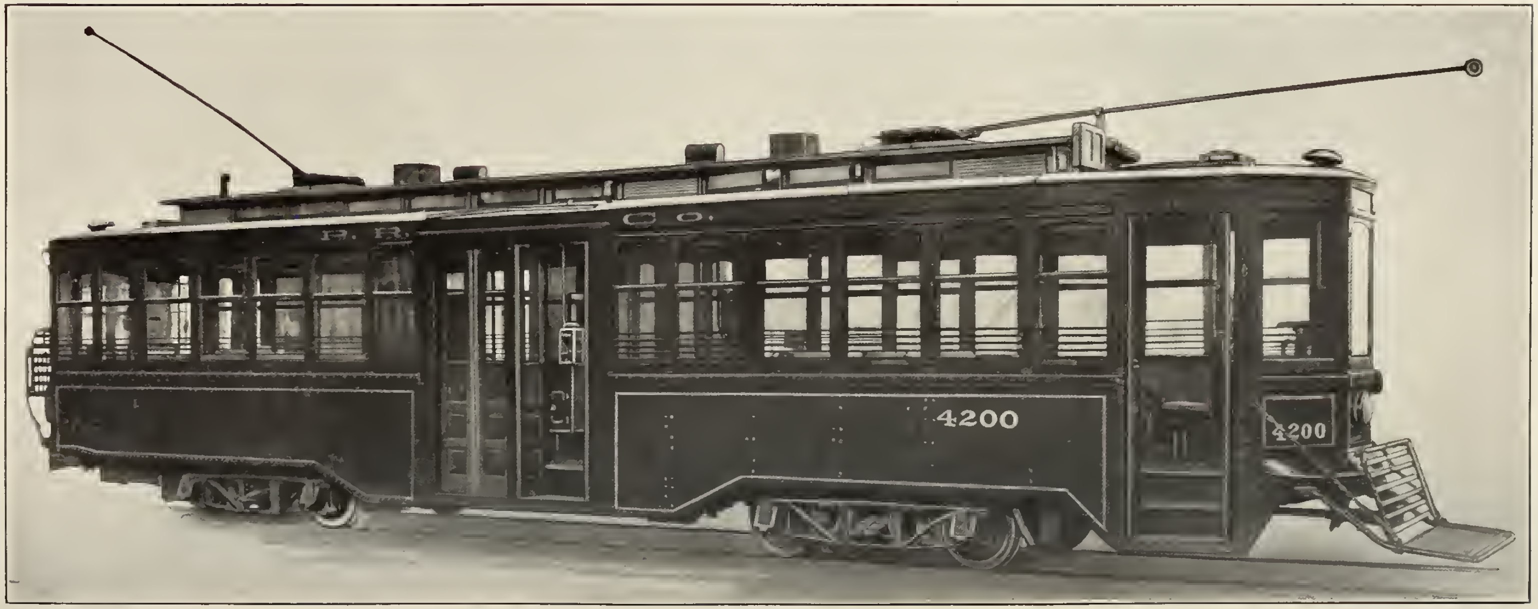


LOW-FLOOR CAR, PITTSBURGH RAILWAYS CO.

(Face p. 356.)



ALL-STEEL, SUBWAY CAR WITH THREE SIDE ENTRANCES, BOSTON, MASS.


P. R. CO.
4200
4200

CENTER-ENTRANCE, END-EXIT, SMALL-WHEEL CAR, PITTSBURGH RAILWAYS CO.

for handling crowds going to parks or games and caring for rush-hour traffic from factories; and a duplicate of the New York car has been ordered for Columbus, Ohio. Both double-deck cars are, of course, of recent construction, and the opportunity for trial has been limited.

The new types of cars for interurban service and for heavy electric traction are less numerous and less divergent from previous types. The steel cars of the Cambridge Subway probably show a greater departure from generally accepted standards than any of the other large cars of the year. They are equipped with three side doors, and the usual platforms, bulkheads, and platform doors have been eliminated. One of the doors is located at the center of the car, and the other two are approximately over the trucks. This plan divides the car into four sections and gives, in the longer car, the same effect as the center entrance so notable in the new designs for city service.

In general, the use of steel for car bodies has shown a marked increase. All except two of the new types of city cars have depended upon the girder effect of the side sheathing between belt rail and sills to support the load, the strains being carried around the doorway by heavy reinforcement, and it is manifest that this construction is to be perpetuated. In fact, with the existing demand for light-weight cars, such a form of steel construction seems to be obligatory, as the low records for weight established during the year were obtained through its use. For the same reason it would seem that the adoption of wheels of small diameter would become general in slow-speed service, as their practicability has been thoroughly demonstrated.

Double-deck Pittsburgh cars.—These cars in use on the Pittsburgh railways are intended not only for special service to parks, ball games, etc., but for regular runs on one of the city lines. On this line, however, 75 per cent of the passengers are loaded at five points in the central part of the city. Contrary to the somewhat prevalent belief that the double-deck design involves an enormously high first cost, the quotations which were made for the five cars were found to be exceedingly low considering the increase in seating capacity. In fact, the actual price paid for each amounted only to approximately $1,500 more than the cost of a standard single-deck car.

The cars are carried on small wheels to permit the use of a low main floor which is only 28¾ inches above the rail. The center portion of the main floor is depressed to form a well from which the stairs extend to the upper deck and which also provides space for separate entrance and exit doors. The two stairways are located on both sides of the car, but face in opposite directions, the exit stairway having its floor alongside of the front doorway, which is used only as an exit. The stairway for ascending passengers is, in consequence, on the opposite side of the car from the door which is used as an entrance, and the fare box, behind which the conductor is stationed, is near the foot of this stairway. This arrangement provides a loading space having a length of approximately three-fourths of the width of the car, and gives room for about eight entering passengers between the door and the fare box.

The seats on the upper deck are longitudinal and are arranged back to back in the center of the car, the space underneath the seats providing a clear head room for the first floor of 6 feet ½ inch. These seats are curved outward at the ends of the car so that head room for the motorman on the lower deck is provided across the full width of each end. In consequence, the motorman can stand erect on the lower deck without having his movements restricted.

The over-all length of the car is 47 feet 2 inches, and the width is 7 feet 10 inches, both dimensions being approximately standard with the newer single-deck cars of the Pittsburgh railways. This makes the cars shorter but wider than the original, which was built in the railway company's shop by fastening two small cars end to end and putting a second deck over them. The trucks are set on 22-foot 2-inch centers, and each end of the car is in consequence almost exactly balanced over one of the trucks. The over-all height is 13 feet 8 inches, 9 inches less than that of the original, and the clear heights for the upper and lower decks are, respectively, 6 feet and 6 feet ½ inch. The head room at the central wall is 6 feet 3 inches.

The center part of the roof is made 4 inches higher than at the ends, since at the middle section of the car, which is occupied by the well, it is necessary to have a clear head room of at least 6 feet over the full width of the car for both decks. Except at the central well, however, this is not necessary, as the clear head room has to be maintained only in the aisles, and at the sides of the upper deck the floor is depressed 4½ inches to form a walking space in front of the longitudinal upper-deck seats. The depressed ends of the roof have been provided in order to permit the trolley pole to swing out over the edge of the roof on a curve under a low bridge, and also to permit the installation of roof ventilators without adding to the over-all height of the car.

Practically the whole side of the car is designed to act as a beam and the entire weight of the car is supported by this, no underframing being used outside of the two center sills for transmitting pushing and pulling strains. The portion of the car siding which carries out this beam action extends up to the window sills on the second floor. The body bolsters which transmit the load from the sides to the truck center plates are made up of pressed shapes to form a box girder. The center sills, which serve only as a means to absorb pushing and pulling strains, are made up of two 4-inch channels set with the flanges vertical. At a point on either side of each bolster these two channels diverge, extending at a 45° angle to the ends of the bolsters to take up any tendency of the frame to rack. In the center portion of the car, where they are again brought parallel and close together, they are bent downward under the central well and assist in supporting its floor. Floor beams complete the framing.

The seats on the lower deck are in general transverse, and those on the upper deck are set longitudinally to provide head room in the aisles for the first story. Additional seats are, however, provided whereever space for them exists. Thus on the lower deck two semicircular seats for five passengers each are placed at either end of the car and four single seats next to the well. Four longitudinal folding seats are provided in the center well, of which two, seating two persons each, are located on the blind side of the car opposite the doors. The other two, one alongside each stairway, seat three passengers each, but only one of these seats is used at one time. The semicircular end seats at the extreme ends of the car are stationary, and the one which is at the rear of the car is used to seat passengers, the one at the front being used to provide a space for the controller and brake handles, as described later.

On the upper deck, in addition to the longitudinal seats, there are two transverse seats, each seating two persons, at the ends of the stair wells. These, together with the longitudinal seats, provide a seating capacity for 56 persons on the upper deck, and as the lower deck will accommodate 54 passengers, the total seating capacity of the car is 110. The weight of the car completely equipped is 38,700 pounds, or only 352 pounds per seat.

The separation of the entrance and exit doors by a distance of approximately 7 feet has been found to be very effective in separating incoming and outgoing crowds of people, and accounts to a considerable extent for the rapidity with which passengers have been handled.

One of the schemes for avoiding delay in unloading passengers from the upper deck is the elimination of the usual push buttons from that floor. There is, however, a push button at the head of the exit stairs, and signs are prominently displayed to call attention to its location. Upper-deck passengers are therefore required to be ready to descend the exit stairs before they can signal the car to stop, and, as both the motorman and conductor control the exit door and see the feet of any descending passenger, the chance of carrying anyone past his destination is slight.

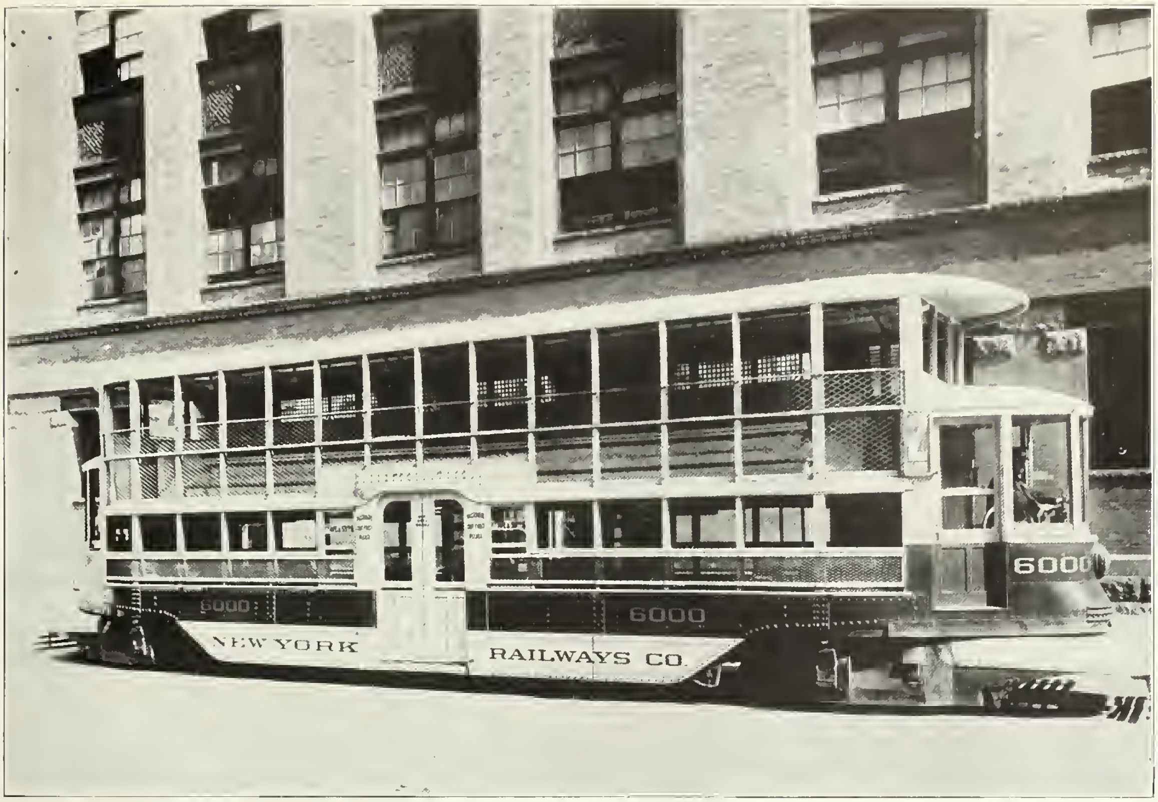
The depressed portion of the lower deck which forms the center well reduces the height of the step from the ground into the car to 13¼ inches. From the doorways there is a slight slope upward to the center line of the car amounting to about 1½ inches, formed by gradually increasing the thickness of the floor strips, a safety tread being provided at the edge of the step. From the well to the main floor of the lower deck there is a step of 12 inches, and a short ramp 2 feet long gives an additional rise of 2 inches, bringing the main floor to a height of 28¾ inches above the rail. Access to the upper deck is effected by a series of eight 9-inch steps which start from a small landing 5¾ inches above the floor of the well. These stairs are restricted in width to 18 inches in order to prevent any possibility of double lines of passengers either ascending or descending, as the fact that the stairs are used only in one direction obviates any necessity for crowding or passing by passengers while on them. Passengers thus have an opportunity to use handholds on both sides of the stairs if the necessity arises, and this minimizes any tendency toward interior accidents due to the presence of the stairs.

The doors are pneumatically operated by the system which has been made standard in Pittsburgh, except that owing to the restricted headroom the apparatus has been reduced in size so that the mechanism takes up no more space than the channels which support the floor. With this device each doorway is provided with two doors, each one of which is equipped with roller supports and guides to define its movement. At the side of the door near the doorpost there is a pin sliding in a guide extending straight inward from the doorpost, so that the outer edge of the door is compelled to travel straight in and out. At a point about one-third of the width of the door from the other edge is another pin which slides in a straight groove, making an angle of about 30 degrees with the plane of the doorway, and this compels this edge of the door to travel across the doorway as would a sliding door. The result of the combined movement of both ends is to make the door as a whole slide into open position around a sharp curve, taking its open position at right angles to the doorway and in line with the doorpost. The two doors in each doorway are mutually operated by means of a simple bell-crank arrangement.

The car is equipped with the "low-floor" type of truck with 24-inch wheels and small motors. Four motors are used, and for their operation a novel form of control has been developed. The master controller is so small that it is placed under the semicircular end seat which is located at each end of the car. Passengers sit immediately over the controller, so that no space is lost on account of its presence at the rear end of the car. When the controller handle and brake handle are removed from their shafts, no space is occupied outside of the vertical partitions installed on the end seats and which really serve as spacers to prevent any passenger from occupying more than a fair share of the seat.

Another novel feature of the car is the provision for keeping all parts of the trolley pole and harp below the high point of the roof, which enables the trolley to pass any overhead structures under which the car itself will

CENTER-ENTRANCE DOUBLE-DECKED CAR.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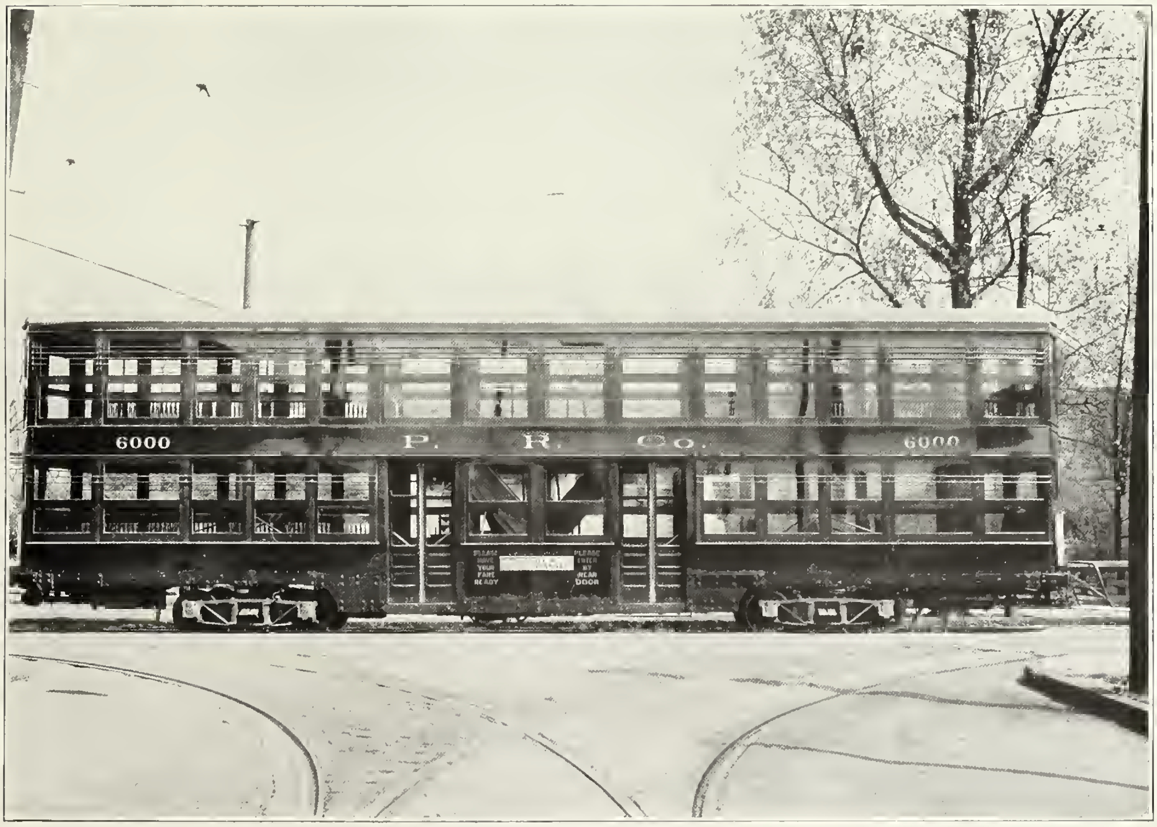
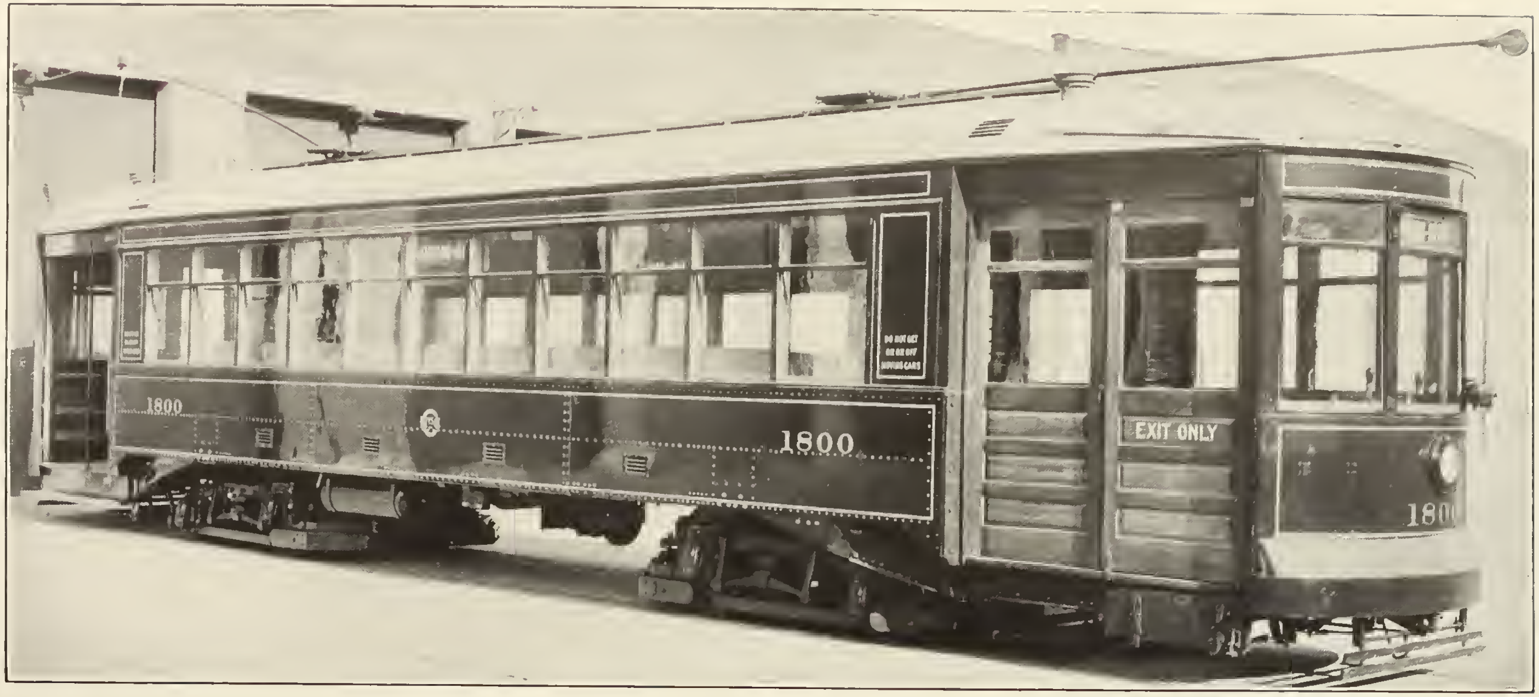
NEW YORK
RAILWAYS CO.

NEW YORK RAILWAYS CO.

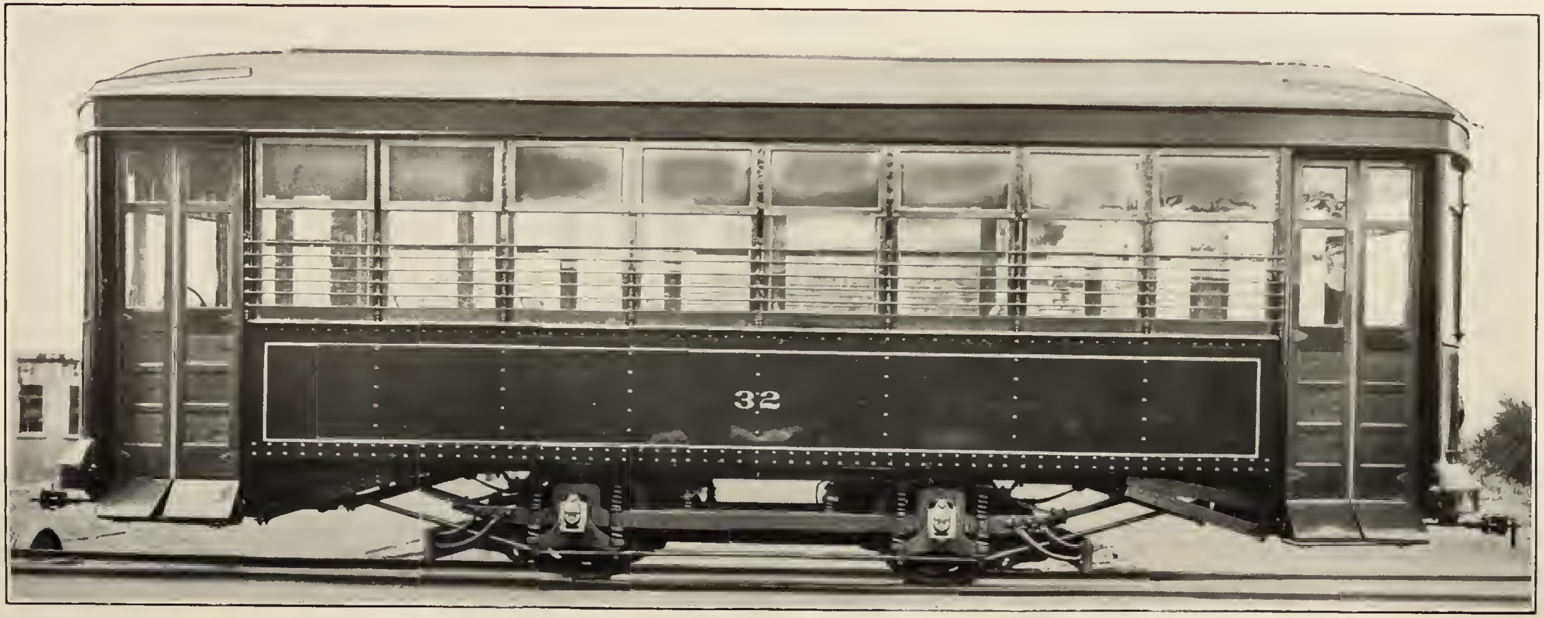

6000
P. R. Co.
6000
PLEASE HAVE YOUR FARE READY
PLEASE ENTER BY REAR DOOR

PITTSBURGH RAILWAYS CO.

(Face p. 358.)


1800
DO NOT GET ON OR OFF MOVING CARS
1800
EXIT ONLY
1800

STANDARD END-PLATFORM CAR FOR CITY SERVICE, CHICAGO, ILL.



SINGLE-TRUCK PAY-WITHIN CAR FOR SERVICE IN SMALL TOWNS, MERIDIAN, MISS.

go. This is effected by mounting the trolley harp and pole in a depression along the center line of the roof, which extends from a point slightly ahead of each truck center to the end of the car. As this depression follows the center line and is only 2 feet 6 inches wide, it does not decrease the head room except within a space extending over the longitudinal seats of the upper deck. In this space, of course, no necessity exists for full head room, because the passengers have no chance to stand upright when they are under it.

Stepless double-deck cars in Columbus, Ohio.—The street railway situation in Columbus differs from that in any other American city in having only one street along which there is traffic congestion. Into the electric railway cars that traverse this street there crowd during the rush hours almost all the persons in Columbus who want to ride to or from their homes and places of business.[1] During the morning and evening rush hours, traffic congestion in High Street throws all the traction lines of the Columbus Railway, Power & Light Co. off schedule, since 10 out of the 16 routes operated by the company converge on that thoroughfare through its busiest section—Broad Street to Long Street—a distance of only two blocks. In an effort to relieve this congestion, several years ago, the company got permission from the municipal authorities to reroute some of the lines so that they traversed the next parallel streets east and west of congested High Street. The riding public, however, had become so accustomed to "taking the High Street cars" that it refused to violate traditions and declined to patronize any other line. So the relief plan was abandoned. The situation which confronts the company has become more serious each year. Two-car train operation was recently tried, but this did not prove satisfactory, because of delays due to long stops. Again, the operating expenses of the two-car plan were considered too large, since, with seating capacity for only 80 passengers, the train required a crew of from three to four men to operate it. The Columbus Railway, Power & Light Co. operates under a franchise which demands next to the lowest unit fare charged by any company in the country. It is obliged to furnish eight tickets for a quarter, with free transfers. It became imperative, therefore, to provide a car having the largest carrying capacity, coupled with the greatest degree of efficiency; and the low-level, stepless, double-deck car was decided upon as the type which most nearly met the requirements.

The reasons for choosing double-deck operation are contained in the following comparative table, which contrasts the double-deck car with other types in respect to operating expenses, initial cost, and carrying capacity.

COMPARISON SHOWING COST AND EFFICIENCY OF DIFFERENT TYPES OF OPERATING UNITS.

	Double-deck car.	Single-motor car.	Two-motor cars with multiple unit control.	Single-ended two-car trains, both motor cars.	One motor car, one trailer, stepless.
Cost of equipment (estimated)	$6,500	$4,903	$9,933	$8,773	$7,203
Seated passengers	83	40	80	80	100
Seated and standing passengers	171	100	200	200	210
Total weight without passenger load, pounds	46,000	35,773	71,546	68,209	61,773
Depreciation per train-mile, cents	1.100	0.830	1.681	1.485	1.219
Cost of energy per kilowatt hour, cents	1.602	1.144	2.288	2.038	1.976
Maintenance per mile, cents	2.058	1.470	2.940	2.940	2.940
Platform wages per mile, cents	5.227	5.227	7.841	7.841	7.841
Total cost per train-mile, cents	11.121	9.526	16.483	15.835	15.232
Cost per passenger capacity per train-mile, cents	0.0650	0.0952	0.0824	0.0792	0.0725

The contrast with the single-ended combinations does not mean much so far as Columbus is concerned, since there are very few loops there. It is only when loops are numerous that this scheme of operation can be used economically, because without loops annoying delays result from switching movements at terminals.

It will be noted also that the wages paid the conductor and motorman on the new double-deck car are the same as those for the single-motor cars and represent a much smaller outlay than the sums paid to operators of the other types. The cost per passenger capacity per train-mile is lower than that for any of the other contrasted types.

Selection of the double-deck car was also influenced by these economic features: Additional safety to passengers by elimination of dangers incident to entrance and exit; greater convenience in entering and leaving car; improvement in working conditions of motormen and conductors; better sanitation through scientific ventilation; elimination of dangers due to premature starting of cars, since they can not start until the doors have been shut; greater facilities for passengers who want to smoke; traffic congestion reduced by increase of almost 100 per cent in carrying capacity per foot of street occupied; decreased maintenance and operating expenses in the handling of passengers.

The new double-deck car is 45 feet 6 inches long over all, having an extreme width over the belt rails and eaves of 8 feet 3 inches. The over-all height from top of rail is 13 feet 2½ inches. The trucks are at 29-foot centers. The framing throughout is of rolled-steel or pressed-steel sections.

The lower-deck floor extends from the center of the car to the edges of the semicircular seats at each end, rising slightly from the center to clear the truck axles. The space underneath the end and cross seats is not floored, and the wheels and truck frames extend up under these seats. This arrangement permits the truck to swing sufficiently to pass around a curve with a minimum radius of 37 feet.

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[1] Electric Railway Journal, Mar. 14, 1914.

The upper deck extends only between the bulkheads which separate the motorman's cabs from the seating space of the lower deck. The stairways are at the extreme ends. Each stairway extends up with three steps to a platform and branches to the right and left with four more steps to reach the walkway of the upper deck. The stairways are provided with hand rails.

The walkway of the upper deck extends entirely around the car except at the stair wells and is 5 feet 1½ inches above the floor at the semicircular end seats of the lower deck. The floor at this point is 19 inches above the rail, and is reached by a ramp from the floor level at the entrance doors. The floor at the entrance is 11 inches above the rail. The upper walkway extends over the longitudinal seats of the lower deck, and, since for this reason it is unnecessary to have it high enough to permit a man to stand erect, it is only 6 feet 8½ inches above the track rails. The seats on the upper deck are placed at the proper elevation to provide ample head room along the center aisle of the lower deck, and are so high that it is necessary to provide a footboard along the full lengths of the seats, which, in giving space for passengers' feet, keeps them from blocking the walkway.

The upper deck is closed in winter and is opened during the summer months by taking out the removable sash and sections of sheathing. The ends of the upper deck are protected against the weather by extension of the first-floor bulkheads, and are fitted with outward-swinging windows.

Safety treads are used at the center doorways and at the doorways of the motorman's cabs, and narrow sections of this tread are used to face the stairway steps and the front edge of the upper-deck footboards.

The car is equipped with maximum-traction trucks of the low-bolster type with outer bolster bearings outside of truck side frames. The driving wheels are 33 inches and the pony wheels 18 inches in diameter. The truck wheel base is 5 feet. The brakes are the inside type. Each truck is designed to receive one outside-hung motor.

The seats of both decks are longitudinal except for the semicircular seats and the two cross seats at each end of the lower deck. The seats on the upper deck are set back to back, and the feet of the passengers seated on them are almost directly over the heads of the passengers who are seated on the longitudinal seats of the lower deck. The latter seats extend from the center entrance space to the end wells of the car. At the end of these seats are two permanent cross seats. The semicircular end seats extend from the cross seats around the end wells. All seats are rattan.

On the basis of 17 inches per passenger, the upper deck will seat 42 passengers and the lower 41, making a total of 83. It is estimated that the car will accommodate 171 seated and standing passengers. The total weight of the car completely equipped is approximately 46,000 pounds, giving a weight per seated passenger of 554.2 pounds and a weight per passenger, standing and seated, of 269 pounds.

The entrance and exit are by the center side doors. These doors are made in halves. The total door width is 50 inches, divided into two passages by a rail so that two streams of passengers may leave or enter the car at once. The doors are electropneumatically operated and are controlled by the conductor.

The entire center of the car for a width of 50 inches is devoted to receiving and discharging passengers. The conductor is seated on a folding seat along the unused center door, and before him is a swinging change desk. Space for 10 passengers is provided on the loading platform. Entering passengers line up before this desk, and after depositing their fares in the fare box pass on toward the seats and stairways at both ends of the car.

A forced-draft ventilator system is provided for the ventilation of both decks. The foul air is drawn through ventilators which are placed along the center lines of the ceilings of both decks and is carried along longitudinal ducts to the motor-operated fan at the end of the car, where it is discharged. The duct for the lower deck is carried between the seat backs of the upper deck, and at the center of the car a riser connects this duct with the one running along the roof of the upper deck. Heat for the car is supplied by electric heaters, 14 being installed on the lower deck and 12 on the upper deck.

New street-car types in Chicago.—The cars purchased in 1912 by the Chicago City Railway Co. were the first inclosed double-end motor cars to be placed in service there. The new cars in general conform to the old-type standard cars and to the over-all dimensions laid down by the board of supervising engineers. They provide a seating space for 54 passengers, equivalent to that of the near-side cars.

The general dimensions of these new cars are as follows:

Length of car over body corner posts, 32 feet 8 inches.
Length of car over bumper, 48 feet.
Width of car over all, 8 feet 6 inches.
Width of car over posts at belt rail, 8 feet 5 inches.
Height of top rail to top of trolley board, 11 feet 7⅞ inches.
Truck centers, 22 feet.
Diameter of driving wheels, 34 inches.
Diameter of pony wheels, 22 inches.
Wheel base of truck, 4 feet 10 inches.
Height of first step above top rail, 13½ inches.
Height from first step to platform, 12 inches.
Height from platform to body floor, 10 inches.
Total seating capacity, including vestibules, 54.
Estimated weight complete, 40,000 pounds.

The design of the bottom framing of these semisteel cars includes departures from the usual designs employed in former Chicago cars. Probably the most marked of these are the side sills, which are inverted fish-belly type girders built of $\frac{3}{16}$-inch steel plate and angles and over-trussed. The top is reinforced by a 2-inch by $\frac{5}{16}$-inch flat bar, and the bottom by a 2-inch by 2-inch by $\frac{1}{4}$-inch angle. Three openings, 6 inches by 4 inches, cut in the three center panels of these side sills, provide for air-duct connections to the cross-seat heaters in the car. In addition to the plate-girder side sills, the sides of the car are over-trussed by $2\frac{1}{4}$-inch by $\frac{3}{8}$-inch steel bars applied on the angle-iron posts 2 feet $10\frac{3}{4}$ inches above the bases of the side sills and anchored at the girder ends.

Another unusual feature in the design of the bottom framing is found in the cross sills. These are arched trusses formed of two $1\frac{1}{4}$-inch by $1\frac{3}{4}$-inch by $\frac{1}{4}$-inch steel angles, the upper one being horizontal and conforming to the car floor, and the lower one forming an arch from the bottoms of the side sills to the level of the upper member at the center of the car body. These angles are fastened together at the center and the side sills with $\frac{1}{4}$-inch steel plates. This particular design of cross sill is employed because it gives maximum clearance for electrical conduits and other car equipment underneath the center of the car body, and bending tests demonstrate that it is equal in strength to a cross sill of a uniform section carried between the side sills.

The car body is fitted with 13 window openings on each side, the upper sashes of which are stationary and arranged in a continuous frame. All lower sashes are arranged to raise vertically to the level of the continuous bottom rail of the upper sashes. In addition to these, storm sashes are provided at all side windows of the car for use in extremely low temperatures. The sashes are single, two-pane, and conform in shape to the body sashes, being held in place by three brackets and a lock mounted on each post.

Each bulkhead of the car contains one swinging door and one sliding door, the standard for all surface cars in Chicago. The location of these doors, however, is somewhat different from the present standard, in that the stationary portions of the bulkhead are at the sides of the car instead of in the center. By this arrangement it is possible to give additional length to the four longitudinal seats in the four corners of the car body. In conformity with the general practice in surface railway car design in Chicago, one side of the vestibule is equipped with a sliding door, fitted with manually operated mechanism, which also raises and lowers the step. The opposite side of the vestibule, however, represents a new departure for Chicago in that it is fitted with folding doors and steps divided into two groups. The two exit doors are hinged to the body corner posts, and the two entrance doors are hinged to the vestibule corner posts. Each pair of doors is equipped with a hand-operating device, which also raises and lowers the steps. In order to make the operation of these folding doors and steps as easy as possible, the operating mechanism is fully equipped with ball bearings.

Other innovations in the vestibule equipment on the new cars include a light signal system connected with the platform folding doors, which indicates to the motorman whether the doors are in the open or the closed position. In earlier cars the motorman's and conductor's seats have been separate from the hand rail dividing the entrance from the exit aisles. The specifications for the new cars provide that these seats are to be fastened to the platform railings by pivotal brackets and made adjustable for height. When the seats are not required, they may be folded and swung over to one side clear of both aisles.

Each car is fitted with 18 cross seats. The arrangement of the doors in the bulkheads provides additional length for the four longitudinal corner seats, but in order that the aisles may be clear at the rear end of the car, all four of these longitudinal seats contain collapsible sections adjoining the bulkheads. Two collapsible wooden seats are also installed in each of the vestibules. One of these seats provides for four persons and occupies the space along the closed folding doors in the front end of the car, and the second seat is for two persons and occupies the space against the closed and locked swing door in the bulkhead.

No fewer than 200 low-step, double-end, arched-roof motor cars have also been added to the rolling stock of the Chicago Railways Co. A careful check of all the weights of material entering into the construction of the new two-motor cars shows that a reduction in weight of more than 10,000 pounds has been made as compared with the 1911 arched-roof four-motor car, despite the fact that the new cars are 3 feet 5 inches longer than the 1911 type, being of 48 feet 5 inches as against 45 feet over-all length.

The aisle width in the finished car is 25 inches between end-seat plates, but further effective aisle width was obtained by offsetting the seat backs 2 inches. The wide, comfortable seats are $36\frac{1}{2}$ inches over all, and this length was obtained by making the sides of the car as compact as possible. The inside finish is set back of the post line, thus reducing the thickness of the sides of the car body to $1\frac{7}{16}$ inches, and adding effective width to the seats. The floor construction is also quite unusual. The floor is built of a single thickness of $\frac{7}{8}$-inch matched flooring under the seats, and the aisle is doubled in thickness by wooden floor mats. The single floor is insulated with a heavy two-ply felt paper, cleated up with light wooden strips. Over this paper a heavy coat of paint has been applied to increase its waterproof qualities and provide extra insulation.

Other construction features in the car body include a careful study of the installation of the auxiliary equipment on the under side of the car floor. The location of each item was selected after a careful estimate of the moments so that the complete installation would balance around the longitudinal and transverse axes of the body. The small deflecting gutter over the entrance and exit doors was formed by setting a strip of poplar in a heavy coat of white lead on top of the canvas roofing.

Low steps in double-end cars require a very careful study of every item affecting their height if the minimum is obtained. This was especially true of the Chicago Railways cars, which have a total height at the center of the car floor of 37 inches above the rail. The height of the first step above the rail is 13 inches and that to the platform is 11 inches. A 10½-inch riser at the threshold plate and a 2½-inch ramp from the bulkhead to a point in the floor above the bolsters, a distance of 5 feet, makes up this total height. The slight pitch of the ramp is scarcely noticeable to passengers entering or leaving the car. To obtain this over-all dimension, it was also necessary to take advantage of minimum over-all dimensions in the design of the trucks, motors, and bolsters. By the use of a 32-inch driving wheel instead of the 34-inch wheel which has been standard on the Chicago Railways, an additional reduction of 1 inch in height was obtained.

An interesting feature in the construction of these new cars is the practical application of safety principles in their design. A number of new departures in the design of the air-brake equipment were included to accomplish this end. One of the innovations in connection with this air-brake equipment is an emergency valve which makes it possible for the motorman to get an emergency application at the brake valve, the air being taken directly from the reservoir. At the same time the brakes are applied and sand is automatically deposited through air sanders. In addition to these, a conductor's valve is placed in each vestibule so that an emergency air application may be made by him if necessary.

A number of safety appliances were also incorporated in the brake apparatus under the car body. In case the pin connections break, the air-brake apparatus is left operative, as the loop or boxed-over end of the rod holds it in position.

Following the standard Chicago practice, a single sliding door is provided on the exit side of the front platform, connected to the step, which raises when the door is in the closed position. The sliding door does not recede into a pocket, the partition forming it having been removed, so that the exposed door slides along the side of the vestibule. A two-piece folding door on the opposite side of the platform opens and folds against the controller. It differs from the doors used in the older types of cars, which were four-piece. Another departure consists in a long slatted seat, so placed and connected that when the door is in the closed position the seat is lowered and the step is raised. One end of this seat is hinged to the front of the vestibule, and when it is raised to clear the doors it actuates levers which lower the steps.

The conductor's and motorman's rails are about the same as those on the platforms of the older cars. The center leg of the rail is equipped with a bayonet lock in the bottom casting. This locks it into the floor socket when it is in position and it may be unlocked by raising a sleeve set on the leg just below the rail. The other two legs are made with partial flanges at the base so that they will hook into slots in the sides of the floor sockets when the rail is in position. In order to engage the locks, it is necessary to tilt the rail to insert the two outside legs, which when raised to a vertical position are held rigid by the bayonet lock on the center leg. The hand-brake staff is set close against the front of the vestibule, and the handle is designed so it can be fastened against the vestibule to give more platform space.

Each side of the car body contains 11 windows equipped with brass bottom sashes and arranged to raise into pockets provided at the top of the window opening. The top sash is built of wood and is continuous from end to end of the car body. The fact that it is continuous and is permanently attached to each post by screws materially increases the stiffness of the car sides. In order thoroughly to insulate these windows against extremely low outside temperature, storm sashes are provided. Each side of the car is fitted with three sections of three windows each and one section of two windows. The new wooden storm sashes, which weigh 15.7 pounds per window as compared with 18.7 pounds for the old metal sashes, represent a reduction in weight of 17 per cent. They are fastened to each post with four screws, three of which are used to hold the window guards. These screws are set into brass castings fitted into pockets in each post. This manner of fastening these sashes makes them much tighter than the old metal sashes, which were attached by locks and clamps.

The curtain rolls are exposed so that the curtains may be cleaned on both sides as they pass over the rolls. They are set into shallow recesses at the top of the window openings, and the curtain fixtures are covered with neat brass caps. Another simple innovation which aids materially in cleaning the cars was included in the manner of installing illuminating signs. These sign boxes in the vestibules and at the center windows in the car sides are hinged at the top and fastened at the bottom with catches so that they may be released and swung away from the glass to permit cleaning. In the old cars the sign boxes were permanently installed, so that it was possible to wash the glass only on the outside of the car.

The mechanical department of the company, in selecting the interior finish of the car body, endeavored to make it as light as practicable to increase the efficiency of artificial illumination. Accordingly, the head lining was finished in light buff, and the trim was finished in natural cherry. This improved the car illumination 50 per cent over the old pea-green head lining and stained-cherry finish. An actual test of the average illuminating qualities of the new as compared with the old car finish shows that the illumination at the aisle seat of the new car is 4.34 foot-candles as against 2.78 foot-candles for the old car. Birch finish was used in the first 25 cars for test purposes. It not only was much cheaper than cherry, but at the same time was just as satisfactory for interior finish. Owing to the tendency of birch to warp, however, it was necessary to use cherry for the door stiles and crossbars. The panels in these were made of birch and the two woods blended almost perfectly.

Chicago Elevated all-steel cars.—At the close of 1913 the Chicago Elevated Railways placed an order for 128 all-steel arched-roof cars, which may be regarded as the latest to be employed in that class of work. A fireproof car was desired which, at the same time, would not weigh more than the heaviest cars now used by this company. This design was also considered more economical from a maintenance standpoint, as it was believed that this type of car would have a much longer life than those of composite construction. For the previous four years the growth of the elevated railways was limited by the capacity of the Union Loop. This could accommodate 700 cars an hour, and about this number were being looped by the four divisions of the elevated railway system, then owned by as many different companies. About three years ago these were put under a single operating management, following which negotiations for their merger with the surface lines were begun by the city council. In the latter part of 1912 these negotiations were broken off, and in the summer of 1913 the Elevated Railways applied to the city council for the right to rearrange the loop structure to permit through routing of cars. This request was granted, with the result that the capacity of the loop was increased from 700 to 1,200 cars per hour.

From 1909 to 1912 the passenger traffic had increased but little. Consequently, there was no necessity for additional rolling stock. However, following the inauguration of through routing, which was accompanied by the introduction of universal transfers, the traffic showed an increase of more than 3 per cent in one month. In order to meet the abnormal growth, as well as future demands, the new all-steel cars were purchased. The old type of elevated railway car had only two doors, which were insufficient to expedite boarding and alighting to a point where schedules would not be retarded during the present rush hours. To meet this difficulty, the new cars are equipped with three doors, one at each end of the body and one in the center. Their adoption necessitated the use of longitudinal seats, which, however, permit a larger standing load.

The principal dimensions of the car body are as follows:

Distance between center of trucks, 33 feet 8 inches.
Length of car body on center line over end plates, 48 feet.
Length of car body over corner posts, 37 feet 10 inches.
Extreme width of car over window sills, 8 feet $8\frac{3}{16}$ inches.
Width of sliding door opening, 3 feet 8 inches.
Height of car from top rail to top of roof, 12 feet 3½ inches.

The car body is built throughout with structural-steel and pressed-steel shapes, and is designed with continuous structural-steel center sills and plate side girders. The lower members of the side girders form the side sills, and the upper members form the letter boards and deck plates above the windows. The floor and side framing is designed to include cross-bearers which transfer the floor load to the side trusses. Special precaution against the destructive effect of collisions is provided for in the end vestibule framing. The entire car body, exterior and interior, is made fireproof and is thoroughly insulated against extremes of heat and cold, noise, and the effect of vibration. In fact, the structural steel is so arranged that no part is exposed to both the outside and inside of the car except the sashes. The underframe is composed of 6-inch channels and I-beams, which form the side sills and end sills and the center sills, respectively. Another important feature of the underframing included in the design is contained in the body bolsters. These are made of two soft-steel plates with a cast-steel separator in the center. The steel casting, in addition to serving as a separator for the top and bottom plates, is designed to form a housing for the draft springs by extending it beyond the bolsters toward the end of the car body. The center-bearing plates are also of special design and provide for self-lubrication, giving also large contact and wearing areas. The center plates are designed with an oil well surrounding the upper member of the bearing plate which, when filled, permits this member to operate in oil. Each bolster is equipped with a roller side bearing.

The side and end framing of the car body is made up of pressed-steel sections, sheathed on the outside below the windows with 3/32-inch cold-rolled steel plates, which are secured to the posts, belt rail, side sills, and other parts by rivets. The entire interior finish of the car excepting the arm rests on the windows is supplied in a special material—finished mahogany. The floors are of a fireproof, sanitary composition.

At each end of the car are provided vestibules which afford entrance from each side and from the ends. The right-hand corner of each vestibule, on the motor cars, contains a motorman's brake valve, air gauge, master controller, and other necessary apparatus inclosed in a cab formed by a door hinged to swing approximately 120 degrees. This door in one position forms one side of the cab, and in the other it engages with a swinging panel which forms a part of the finished bulkhead.

The body is fitted with six sliding doors, two at each end of the car and two in the center. These doors recede into pockets provided in the car body and are operated with pneumatic apparatus, either from the guard's niche or from the motorman's cab. They are made of pressed steel, suitably insulated, and are 1¼ inches in thickness, being equipped with rubber cushions and weather stripping. The vestibules are fitted with doors at the ends to permit an uninterrupted passage from one car to another.

Twelve windows are provided on each side of the car body, the upper sash being fixed and the lower sash arranged to be raised. The sashes are made of bronze and are fitted with brass stops and curtain grooves. Both the upper and lower sashes are glazed with $\frac{3}{16}$-inch plate glass, set in rubber channels. The car body is provided with four longitudinal seats 16 feet 4¾ inches in length. These are provided with 2-foot 6½-inch spring backs built into the car body. Both the backs and the seats are upholstered in canvas-lined rattan of small mesh. Twenty-four sanitary hand straps, six on each side of the car ceiling in each end of the car body, are provided for the convenience of standing passengers.

An electric heating system of the forced-ventilation type and provided with a thermostat control will be installed in each car. This system is operated in conjunction with eight exhaust ventilators installed in the roof of the car. Each ventilator is provided with register control, and the six in the car body are connected to two continuous operating mechanisms. All electric wires, both for the heating system and for the lighting circuit, are inclosed in a metal conduit, provided with junction boxes and other necessary fittings to insulate it thoroughly.

Ingenious articulated car in Boston.—Reference has been made in preceding paragraphs to an ingenious new form of articulated car devised in 1912 and put into use by the Boston Elevated Railway Co. for its regular street-car service. This car, which represented the most novel design placed in service in urban traction work during the year, consisted of two of the company's old 20-foot closed cars with one vestibule and platform removed from each, the two units being assembled into a single car 62 feet 10 inches long over bumpers, through the use of an intermediate compartment flexibly connected with the two end sections and serving as a center-entrance prepayment platform. In this car access to the intermediate compartment is had by means of a folding step attached to the outside of the compartment in front of the doors and about 11 inches below them.

The main object sought in the design of the car, aside from its effective utilization of a heavy investment in small rolling-stock units of low carrying capacity, was to obtain a car capable of holding at least as many passengers as the standard semiconvertible cars owned by the company, to produce a piece of rolling stock which could be used on narrow streets and on short curves without dangerous overhang, and at the same time to provide improved facilities for convenience and safety of passengers when entering or leaving. The first car of this type has been in service since early in September, 1912, and has met with complete success, both from the company's point of view and from that of the public. A second car of this general type has lately been placed in commission, and a number of improvements have been effected in its design, the most notable feature being the adoption of the principle of stepless operation. In the new car the floor of the center section, where the doors are located, is arranged with a lower level than in the first car of the type, so that passengers step directly from the street into the intermediate compartment, which is located 14 inches above the roadway. This is an unusually low height of step, and the car may, in fact, be considered stepless in the same sense as the so-called stepless center-entrance cars now operating in Manhattan and Brooklyn Boroughs, New York City.

The general design of the car is similar to that of the first one, but the utilization of the stepless principle made a number of changes necessary in the underframing of the intermediate compartment. After the passenger has stepped into the center compartment and deposited his fare in a fare box in the middle of the compartment, a second step of 10 inches is taken in order to approach the doorway leading into either end section, and the platform reached by this step has a ramp with a rise of 2 inches between its outer edge and the step riser which is surmounted prior to entering the end section. As in the first car, this riser is 5 inches in height. The lowering of the center platform has been accomplished by offsetting the center sills of the central or intermediate compartment, the side sills being supported at the same height as the lower portions of the center sills by channel irons passing through center-sill reinforcing plates and resting on the bottom members of the center sills. A change has also been made in the bolster arrangement, the side-bearing plates resting on top of rollers carried on the top of the bolster support instead of on the end sills of the cars. This permits the use of a flooring about 8 inches wider for the passageway between the intermediate and end sections.

The flexible curtain inclosing the passageway between the intermediate and end sections of the car has been materially improved, and instead of using a continuous diaphragm the bonnets carried by the end sections have been arranged with horizontal hinges permitting vertical movement of the outer ends of the bonnets, which rest in each case on the top of the end wall of the intermediate section. This allows for all necessary movement between the units and at the same time makes a waterproof joint, providing at all times a ceiling line parallel to the floor line of the intermediate compartment and thus enabling the sides to be closed with spring-roller curtains.

One-man prepayment cars.—One of the interesting developments of the period in creating new facilities for street-car travel has been the return of the old type of car exemplified by and famous as the "bobtail," operated by one man who in addition to driving his team was supposed to be able to play conductor as well and see that all the fares were paid, besides making change when called upon to do so. The introduction of electric power soon drove off the streets the bobtail horse car, which had shown ability to stand other competition; but now the success of the modern prepayment car methods has brought "on the map" new types of the one-man car that were not previously practicable. The car has apparently a very distinct place in enabling service to be given in districts and along thoroughfares where heavier cars and more expensive systems of operation could not be supported by existing traffic. Obviously a smaller car can be used, and even old cars obsolete for some other classes of city service can be utilized in the new work. Thus, for example, in 1913 the Detroit United Railway Co. put in operation at Ann Arbor, Mich., a city of 15,000 people, a single-truck car combining the one-man operation with the pay-as-you-enter principle. The change from two-man cars was made to reduce the cost of operation and yet give better service. The type of car had become obsolete in Detroit, but still was relatively new and eminently useful for traffic elsewhere. Only a small expense was involved for overhauling. In making the change it was necessary to arrange the vestibules so that the doors could be opened and closed mechanically by the motorman at one end and locked at the other. The usual door-operating mechanism is used, but the handle can be readily removed for use at the opposite end when the car is turned. Thus entering travel is directed through the front door to the fare box under the eye of the motorman-conductor, and it is practically impossible for a passenger to open the rear door and come in. The removal of the bulkhead, except for a portion as wide as the longitudinal seats, gives the operator a clear view of the car interior, while push buttons enable the passenger to signal for a stop. The fare box is installed in a corner of the vestibule just back of the motorman's car controller on the left side opposite the entrance doors. This arrangement is convenient for fare collection and leaves a clear aisle for passengers when boarding and alighting.

A number of statements from street railway managers as to their opinions and experience in regard to the subject afford probably the best guide as to the status of this practice. A survey of this kind was secured during the early part of 1913, and the data given are of much interest.[1] In this connection Mr. R. B. Stitchter, general manager of the Waco, Tex., Street Railway, may be quoted as follows:

> The cars were originally built with a view of one-man operation but so that, when occasions of heavy traffic demanded, they could be operated well with two men. The older types of fare boxes have been in use, and the trainmen are permitted to make change only. We are at this time trying out the later types of fare boxes. The system is so laid out that every car in service passes in front of the company office, the trainmen are supplied with $5 in nickels, and a change man remains on duty during the entire period of operation and keeps the men supplied. Twenty nickels are stacked and held together with a spring clip for the purpose, so change can be quickly and accurately made when required by the trainmen.
>
> The hours of car operation per month will exceed 10,000, and the addition of another trainman per car-hour, at 18 cents, would mean an increase of $1,800 per month. The saving does not amount to this much, however, as at present some of the lines have such heavy traffic that, the cars being of the single-truck type, it has not been found possible to operate with one man and make sufficient headway. There are other lines which during the heavy traffic period are supplied with an extra man to each car to act as motorman, the regular man during such period of heavy traffic confining his duties to acting in the capacity of conductor.
>
> There are 24 cars on the system, all arranged for one-man operation. During November, however, four double-truck motor cars and four double-truck trail cars were received and were greatly praised by the mayor and members of the city commission and others interested in the city's welfare and development. These later cars embody the single-man, pay-as-you-enter feature, with outside closing doors operated by the motorman, are provided with cash fare boxes, and are without bulkheads. The side framing consists of T-irons, extending from the floor framing up one side and down to the floor again on the other side, in one continuous piece. All of the motor cars are equipped for double-ended operation except four. The amount to be expended to convert old-style cars to one-man pay-within cars depends on the number of car-hours, the rate paid the trainmen per hour, and other local conditions which are easily ascertained and secured in each particular case.
>
> We expect trainmen to request payment of fare, cash, ticket, or transfer, the same as in two-man pay-as-you-enter operation. All fares are registered on a double-fare register as cash or tickets. Transfers are issued at certain transfer points. We have not tried a transfer-issuing machine. The trainmen are instructed to announce streets and to assist only elderly persons on or off the cars. Our pay passengers per car-mile average a little in excess of four.
>
> One-man operation gives a little slower schedule than two-man operation. The schedule, however, under proper training and proper inspection, in our experience, is sufficiently rapid to please all patrons, and, in fact, is as rapid as safe conditions of operation will permit, regardless of whether the car is operated by one man or two men.
>
> Our observation shows that a single-man car, provided with lever to operate folding doors and steps, if properly operated, is practically as safe as when operated by two men, and the number of accidents and the amount of damage resulting from one-man operation do not exceed to any perceptible degree those with two-man operation. As previously stated, however, when the traffic gets heavy, in order to make the same schedule, it is necessary to provide two men, and the results, from the accident standpoint, depend largely on the provision by the superintendent of inspectors of two men just at the time when traffic becomes sufficiently heavy to justify it.
>
> The attitude of the public toward the one-man car seems to be very favorable. There is no objection to it whatever except in certain localities where a large proportion of the passengers are negroes, and

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[1] Electric Railway Journal, Mar. 29, 1913.

in such cases it sometimes becomes necessary, harkening to public opinion, to segregate the negroes in the rear of the car and permit them to enter and leave through the rear. In the case of one-man-operated cars it is ordinarily required that all passengers enter and leave by the front entrance.

Our experience with the one-man-operated car is that it very often enables the traction company to give street-car service in thinly populated districts where, if two-man-operated cars were required, such service could not profitably be maintained, and with the exception of lines blessed with quite heavy patronage the system of operation can be so laid out that very economical and satisfactory service can be given to the public.

Mr. H. W. Waggener, general superintendent, Atchison (Kans.) Railway, Light & Power Co., says:

The cars we operate are the ordinary semiconvertible single-truck cars with both rear and front platforms. The rear doors are kept closed and no fare boxes are used. We supply $5 in change to the trainmen. We have eight cars, all double-end. We instruct trainmen to exact prepayment of fare in all cases on one-man cars. The fares are registered by hand. Transfers are issued when passengers leave the car at the junctions. The motorman announces streets and assists passengers in boarding and alighting, or with heavy packages, etc., if they need assistance.

The average number of passengers per car-mile on our one-man cars is 4.8. The maximum speed of the one-man cars is 8 miles per hour. The schedule speed is 7 miles per hour. There has been no effect on our schedule speed from the introduction of one-man cars. We have employed a second man when traffic is heavy; he stands inside of the car at the front end and collects and registers the fares. So far as our observation goes the number of accidents has not been increased by one-man operation. We have never had any trouble with passengers, but many of them buy tickets to save trouble in making change when they enter the cars. All objection on the part of our public against one-man cars disappeared in a short time.

The saving in platform expense due to the use of one-man cars is not offset by disadvantages of any kind. We have received advantages from one-man operation in addition to our reduction in platform expense. All fares are apparently registered, and a saving has resulted of $2 per day on each car. This city has between 17,000 and 18,000 inhabitants. We came to the conclusion that one man could collect fares and register them practically as quickly as could be done with a conductor, and it became a question of cutting expenses; hence the adoption of the system.

I certainly recommend one-man operation for companies in small cities and for the outlying lines of companies in large cities, especially where the schedule is not too fast. For a number of years our cars were operated as one-man cars, passengers paying their fare when they left the car, but about two years ago this method was changed to payment as the passengers entered. This last arrangement has been much more satisfactory to the general public. On holidays, such as the Fourth of July and other big days, when the traffic is particularly heavy, it becomes necessary for us to put on a conductor during the congested hours only.

Mr. Attillo Norman, treasurer, Freeport (Ill.) Railway & Light Co., says:

Four of our cars were originally for one-man operation and two were reconstructed. The cars are double-end. Registering fare boxes are used, and very little expense was necessary to remodel our old-style cars for one-man prepayment operation. We instruct trainmen to exact prepayment of fare in all cases on one-man cars. Trainmen register fares by hand and issue transfers in the usual manner. The motorman announces streets or assists passengers in boarding and alighting, or with heavy packages, etc., if they need assistance.

Our average number of passengers per car-mile on one-man cars is about three and one-half. Our schedule speed is 8 miles per hour. Our runs are short, and this includes turning time. There was no effect on our schedule speed from the introduction of one-man cars. We have never employed a second man on our one-man cars. So far as our observation goes, the number of accidents has been decreased by one-man operation. Our car-mileage is greater with the one-man cars than with the two-man cars operated previously. Our traffic has increased, but we are not sure that this was not due to other causes.

The attitude of the public toward one-man cars at the beginning of operation was that it was willing to have us try them out. Sentiment seems favorable now. The saving in platform expense due to the use of one-man cars is not offset by disadvantages of any kind. We have received advantages from one-man operation in increased receipts and fewer accidents. We introduced one-man operation for the purpose of economy in operation and because we expected increased receipts and fewer accidents. We recommend one-man operation for companies in small cities and for outlying lines of companies in large cities.

Mr. Samuel Barnes, general manager, Cape Girardeau-Jackson (Mo.) Interurban Railway, says:

We have operated our one-man pay-as-you-enter cars for a little more than two years. We were about the first company to operate one-man cars. During this time we have had but one accident. We feel that this is due mostly to the fact that the motorman is placed in a position where he realizes that he is wholly responsible for the car operation and is not depending on the efforts of any one else to avoid possible accident. Furthermore, we have some 7 per cent grades running straight toward and within one block of the Mississippi River banks or levee. When going down this grade, if the car gets beyond the motorman's control, it is necessary for the motorman to throw off the overhead switch and reverse the controller seven or nine points to allow the motors to generate sufficient current to hold the car to a controlling point of speed. Previous to the one-man operation this effort to avoid a runaway with the car on the down grades depended on the conductor to some extent, and at such times he was liable to be inside of the car collecting fares; but under the new system the motorman has quicker access to the means of remedy. There are other instances wherein the one-man pay-as-you-enter car is far superior to two-man car operation.

We reconstructed our cars ourselves. Each man has to furnish his own change, $10. There are six one-man cars on the system, or 10 cars of all types. One-half of the cars are single-end and the remainder are double-end. The expenditure that a company would be justified in making to remodel old-style cars for one-man prepayment operation depends on the type of car and general traffic conditions. Our single-end cars cost $240 per car and our double-end cars $480 per car to reconstruct. We instruct trainmen to exact prepayment of fares in all cases on one-man cars. Fares are registered by hand, and regular transfers are issued. The motorman announces streets and assists passengers in boarding and alighting, or with heavy packages, etc., if they need assistance.

The schedule speed on our one-man cars is 9½ miles per hour. We are making just as good schedule time as with the old system. We have never employed a second man on one-man cars. The number of accidents has been decreased by one-man operation. Our car-mileage is greater with the one-man cars than with the two-man cars operated previously. The traffic was affected by the establishment of one-man cars on the start for about 10 days. The change seemed to cause a little inconvenience to the public, but after that everything worked smoothly. Some people were not favorable to the idea of putting change in the box, but this attitude has changed. All the results of one-man car operation are advantageous. We introduced the cars to reduce the cost of operation and improve the receipts, and by all means recommend one-man operation for companies in small cities and for outlying lines of companies in large cities. During big days our one-man cars carry 1,800 to 2,000 passengers per day each. We have had days in which these cars have handled 900 passengers each in three hours.

Mr. J. T. Skinner, manager, Lawrence (Kans.) Railway & Light Co., says:

In preparing cars for one-man operation we simply closed up the rear door and folded up the rear step and put a fare box on the front end of the car. Fare boxes are used. We loan the trainmen for change $10. The one-man-operated cars save approximately 40 per cent of platform labor. We operate regularly 7 one-man cars on the system, but have a total of 11 double-end and 3 single-end cars.

A company is justified in folding up the rear step, closing the rear door, putting the fare box or register on the front end of the car, and going ahead without any further changes except to adopt the near-side stop. We instruct trainmen to exact prepayment of fares in all cases on one-man cars, except where the trainmen know that the person will hunt out the fare and drop it in the box before leaving the car. Old people and women with children and bundles will frequently take a seat near the front end of the car, hunt out the fare, and drop it in the box after the car has started.

Trainmen ring up fares by hand as they are dropped in the box. If the car has a clear running space, the trainman punches his transfers with the car in motion. If not, the transfers are punched and handed to passengers as they leave the car. Only about 10 per cent of the passengers require transfers. Trainmen announce transfer points and streets for strangers. Our average number of passengers per car-mile on one-man cars is about four. Our maximum speed on one-man cars is 20 miles per hour, and our schedule speed approximately 8 miles per hour. Since the introduction of one-man cars, we have used a somewhat slower schedule. When we have large crowds to handle, we open up the rear door and use two men, collecting fares at each end as passengers board cars. This allows a car to be loaded and unloaded quickly. The number of accidents has been decreased by one-man operation. We have not found that certain classes of passengers are more likely to cause disturbance on one-man cars than on a car with two trainmen.

Our car-mileage has been decreased somewhat with the one-man cars on account of the slower schedule. There has been no change in traffic due to one-man cars. The public thought it was a sensible thing to introduce one-man cars on a small road rather than to cut down car service to effect economies. The saving in platform expense due to the use of one-man cars is not offset by disadvantages of any kind. There are advantages in one-man operation in addition to the reduction in platform expense. One man kept busy will render more efficient service than two men partly idle. We introduced one-man operation because there is no need of two men on a small road except during a few days out of a year. I recommend one-man operation for companies in small cities; and for outlying lines of companies in large cities, where the regular riding is light, one man is better than two.

Mr. L. W. Hess, general superintendent, Northern Illinois Light & Traction Co., states as follows:

Our one-man-operated cars are ordinary cars. We close the back doors and make all people get on the front end. In summer we have both front doors open, and in winter the right-hand front door in the direction the car is going. We supply $4 to the trainmen for change. In September, 1912, our revenues per car-mile on one-man-operated cars were $0.1897 and our expenses were $0.0918. We have six cars, and all are operated by one man except on large-traffic days. All the cars are double-end. The amount which a company would be justified in spending to remodel old-style cars for one-man prepayment operation would depend on local conditions.

The trainman records the fares on a fare register. He collects as the passenger gets off and the car is at stop or when he comes to a switch where cars pass. He steps inside at this point and collects fares. Transfers are issued by the motorman, who does not announce streets except when the passenger asks to get off at a certain place. The motorman is required to help all passengers who need it. Our average number of pay passengers per car-mile on one-man cars is 3.93. Our schedule speed is 12 miles per hour under the ordinance. One-man cars run a little faster under certain local conditions than was the practice before. On large days we have employed a second man on our one-man cars. He acts as conductor.

According to our experience, the number of accidents has not been increased by one-man operation. We have never had an accident to a passenger getting on or off a one-man car. I do not think collisions are increased, as the man on the front end is the man to look out for that, anyway. I do not think disturbances are more apt to occur on one-man cars than on a car with two trainmen. Any person who wants to start trouble is usually under the influence of liquor, and the number of the crew would make no difference. Our car-mileage is not greater with the one-man cars than with the two-man cars operated previously. The traffic was decreased slightly at the beginning by the introduction of one-man cars. There was some opposition toward them at first, but this attitude has changed. I think the saving in platform expense due to the use of one-man cars is not offset by disadvantages of any kind.

There are reductions in one-man operation in addition to the reduction in platform expense. The responsibility of operation can not be shifted to the other man, and there are fewer men to bear the responsibility. We introduced one-man operation to economize in expenses, as we can not afford two men on a car. I recommend one-man operation for companies in small cities and for outlying lines of companies in large cities if they want to save money. We have operated our line almost fifteen years and have never had a suit entered in court because of a street-car accident, although, of course, we have had a number of accidents.

Mr. E. E. Downs, general manager of the Belvidere (Ill.) City Railway, says:

The cars on the Belvidere city line were built originally for one-man operation. A remodeled fare box is used. It rests on a pedestal on the platform convenient to the passengers and the motorman. The motorman supplies himself with $10 in change, but 75 per cent of the passengers have the exact fare ready. We operate two double-end one-man cars. We instruct trainmen to exact prepayment of fares in all cases on one-man cars. Fares are recorded by a hand-register cord hanging directly in front of the motorman. Transfers are not issued. The motorman announces streets or assists passengers in boarding and alighting, or with heavy packages, etc., if they need assistance. Our maximum speed on one-man cars is 15 miles per hour. The schedule speed is 7.5 miles per hour. A second man is hardly necessary, except on special occasions, to make change and expedite loading and unloading. At such times he stands in any place not occupied by passengers. One-man operation obviates all loading and unloading accidents, but certain classes of passengers are more likely to cause disturbance on one-man cars than on a car with two trainmen.

At the beginning of operation everybody seemed pleased and took to the new order of things very kindly. The saving in platform expense due to the use of one-man cars is not offset by disadvantages of any kind. I recommend one-man operation for companies in cities of even as high as 40,000 population.

Unusual subway cars for Greater New York.—The New York Municipal Railway Corporation, a subsidiary of the Brooklyn Rapid Transit Co., filed with the public-service commission of New York City in August, 1913, its design for an unusual new type of car intended for subway use, and also exhibited publicly this new car at its car shops. There are no entrance doors at the ends, but each car has three double doors on each side, although it is proposed to operate only the center pair during hours of light travel. All the doors are pneumatically controlled by the guard, who is elevated on a pedestal alongside the idle pair of center doors, from which position he is able to see all passenger movement with ease. End doors are also provided for going from car to car. The seating plan is such that permanent and temporary longitudinal seats are provided near and in front of the doors, while one row of transverse seats is placed midway between the two pairs of side doors. These transverse seats are of the back-to-back design, one bench being wide enough for three passengers and the other for two. With all doors on one side in use, the car will seat 78, but when operation is limited to the center doors it will seat 98 passengers. All cars are motor cars, in view of their great capacity and length, namely, 67 feet. The outside color of the cars is dark green; the interior is light enamel. Mechanical ventilators are used.

The following comparisons are made by the New York Municipal Railway between this car and that now used in the subway service of the Interborough Rapid Transit Co.:

	New York Municipal Railway car.	Interborough Rapid Transit subway car.
Length	67 feet	51 feet 5 inches.
Width	10 feet	8 feet 8¾ inches.
Seats:		
In rush hours	78 persons	44 persons.
In nonrush hours	98 persons	46 persons.
Average walk per passenger from seat to door	82½ inches	90 inches.
Length of train (eight cars)	538 feet 4 inches	513 feet 5 inches.
Total space in train available for passengers	4,711 square feet	3,702 square feet.

The company estimates that with a train load of 1,200 persons, that now carried in the present 10-car subway trains during rush hours, eight cars only of the new type would be required. With 150 passengers per car 78 would be seated and 72 standing. As there is 370 square feet of standing space per car, each standing passenger would have an average of 5 square feet.

Improved California-type cars.—During 1913 the United Railroads of San Francisco placed in service 65 new cars of the California type, which in general embodies the idea of having open sections of the car at each end with a closed section in the middle. The principal dimensions are as follows: Length over bumpers, 47 feet; length over corner posts, 32 feet 4 inches; outside length of closed section, 15 feet 4½ inches; width over drip rails, 9 feet 2 inches; height of roof above rail, 11 feet $3\frac{5}{16}$ inches; truck centers, 20 feet 10¼ inches; truck wheel base, 4 feet 6 inches. The entire side plate is designed to act as a plate girder, using the side sills as the bottom chord and the $\frac{3}{32}$-inch side plate as the web plate, with intermediate stiffener angles at each side post. The upper chord is composed of angle iron, cut out at each side post, in addition to which there is an over-truss rod of flat bar steel to take a portion of the platform load. This method of side-plate construction does not in any way depend on the side post for strength, thereby allowing the use of a very light side post, which gives the car a light appearance above the window sills.

The floor area of each platform, 46.25 square feet, is larger than that of any other car previously in use in San Francisco and is of great advantage in loading and unloading. On observation the company has found that 25 persons can stand on the rear platform, which is a great help during rush-hour loading at congested points. Stop-watch tests have shown the average loading time per passenger to be 1.1 seconds, and for unloading by front exit only, 0.95 second per passenger. Great consideration was given to step and platform design, which is the heart of the prepayment type of car. The distance to the first step from the street is 15⅛ inches, from the first step to the platform 12⅛ inches, and from the platform to the car proper, with the use of a 2-inch platform ramp, 10 inches. This arrangement places the floor of the car only 39¼ inches above the head of the rail.

The conductor's railing, which can be locked up to the ceiling, is designed to give the maximum-width entrance. It also acts as a motorman's guard-rail and serves to operate the folding step on the blind side of the car, thus making it impossible for the car crew to neglect to raise or lower the step at the proper time.

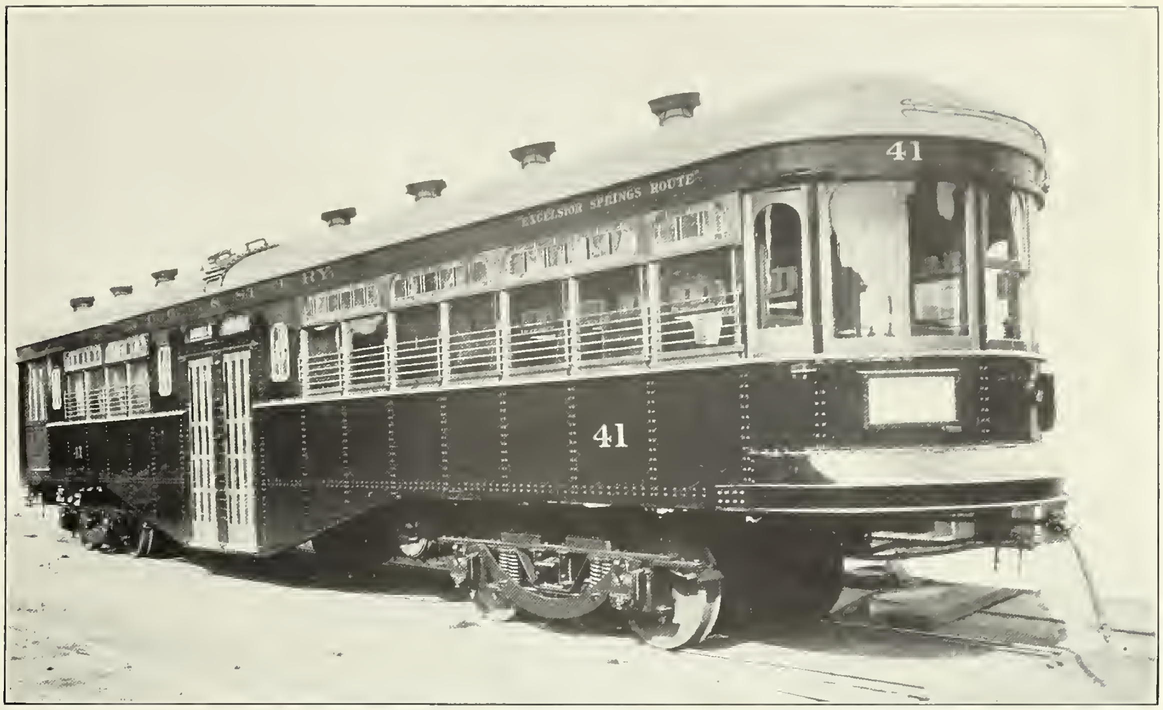
The car has four folding platform seats which are used only on the front end of the car. These seats afford an extra seating capacity for six persons, but interfere in no way with passengers who leave the car by way of the front exit. Wired, polished plate glass, ⅜ inch thick, is set in each side sash of the platform windows to protect users of these very popular seats in case of a slight collision.

All the operating mechanism of the sliding exit gates is concealed behind the panel back for folding the platform seats, which is removable. The mechanism has been so arranged that the momentum of the car does most of the work in opening and closing.

Ventilation for the closed section is obtained through four roof funnels, two acting as intakes and two as outlets. In addition, a perforated panel ventilator is carried at each end of the closed section over the window opposite the door.

Two different seating arrangements are used, varying only in the closed section, where in some of the cars cross seats are used on one side instead of longitudinal seats on both sides. In the cars that have longitudinal seats on both sides of the closed section there is an unobstructed space under the entire length of seats, thus permitting the free use of a vacuum cleaner.

The seats in the open sections are of special design, being pivoted only and not throw-over. They are of slat construction, with natural finish to match the interior finish of the car. These special seats permit a clear aisle space of 31⅛ inches between the cross seats. After careful study and actual tests


EXCELSIOR SPRINGS ROUTE
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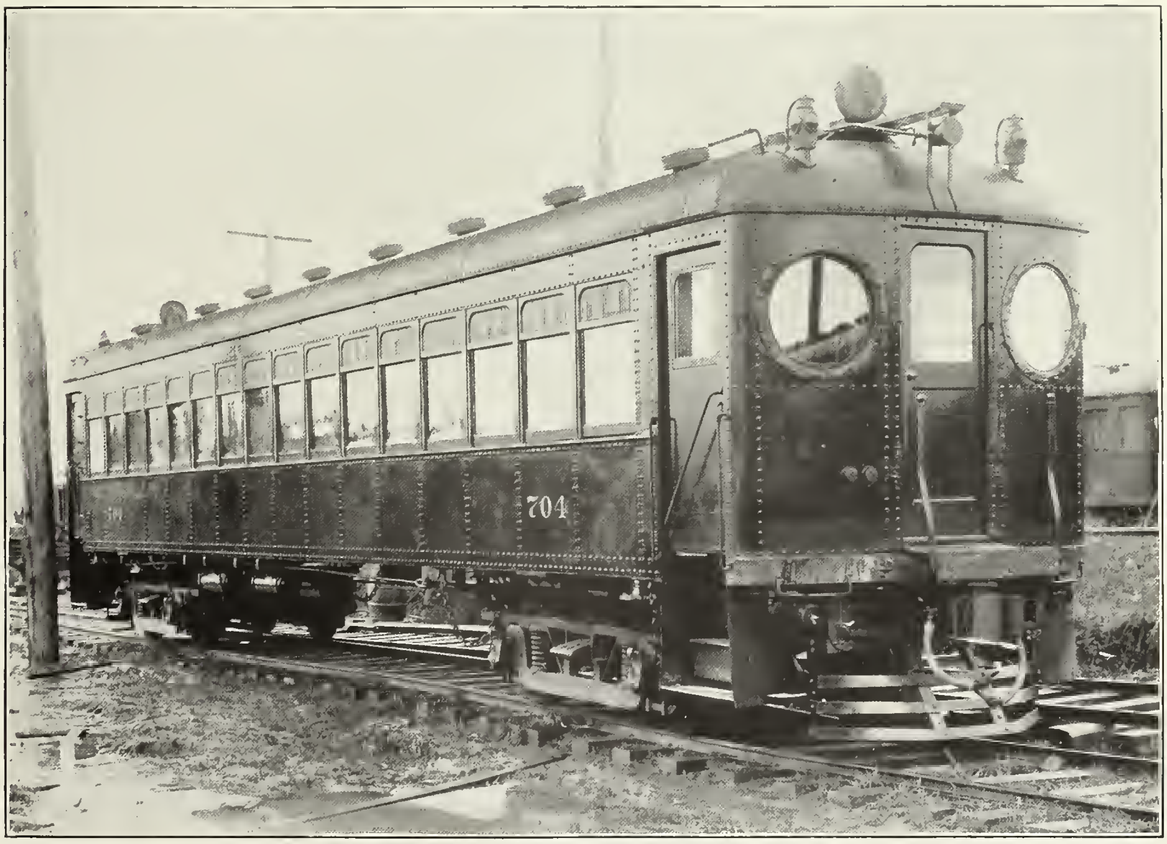
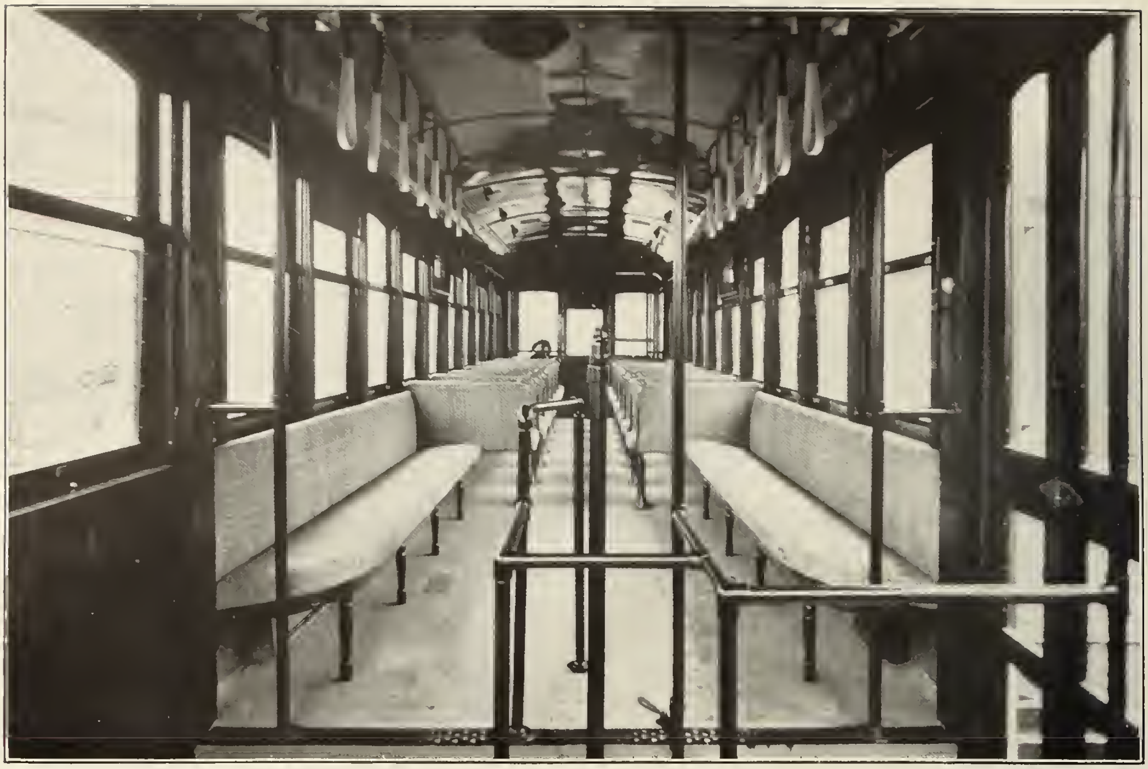
ALL-STEEL, CENTER-ENTRANCE, INTERURBAN CAR, KANSAS CITY, MO.

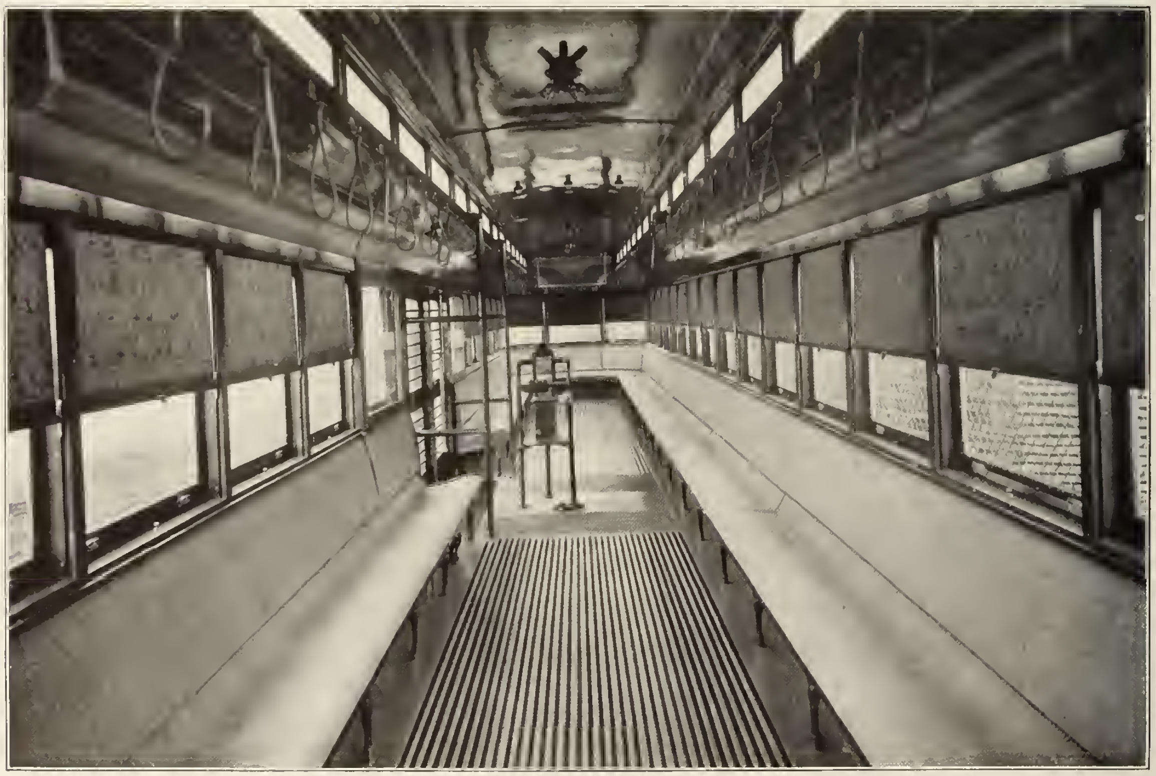


ALL-STEEL, INTERURBAN CAR, PORTLAND, OREG.

(Face p. 368.)



LOW END-ENTRANCE CAR FOR CITY SERVICE, BROOKLYN, N. Y.



TYPICAL CENTER-ENTRANCE TRAIL CAR, CLEVELAND, OHIO.

the company decided to use vertical hand rods in the closed section in place of hand straps. Passengers of various heights, of course, can use these rods with equal comfort. The stanchions and screens at the end sills serve two purposes: First, they define clearly the dividing line between the platform and the car proper, so that the conductor can ask passengers to step into the car; second, the screens act as a guard to prevent passengers who are occupying seats in the open section from putting their feet against passengers who are occupying the folding platform seats. As all stanchions are enameled white, they are easily kept clean.

The seating capacity, including that of the folding platform seats, is 50 for the cars with longitudinal seats on both sides of the closed section and 52 for those having cross seats on one side of the closed section.

Trackless trolley bus.—A trackless trolley bus was put in operation in Merrill, Wis., in 1913, by the Merrill Railway and Lighting Co. The bus seats 18 passengers and is equipped with a 500-volt, 15-horsepower series motor. A five-step railway-type controller and standard resistances are used. The car is of the one-man, pay-as-you-enter type and operates over a route of about 1 mile, connecting at one end with the regular street railway cars of the company. The company plans to extend the bus system to other parts of the city, and also to build one or two suburban extensions. The trackless trolley system was used instead of the ordinary cars on rails, for several reasons. One was that in the mile of route the line crossed three steam railroad tracks and passed over one long bridge. With a street railway franchise, the company would have been obliged to keep the bridge in repair, as well as the roadway between the tracks and for 1 foot outside. This expense was saved, as well as the expense of installing and maintaining three steam railroad crossings. Altogether the company estimates that it made a saving of $70,000 in track, exclusive of repairs and depreciation, and that it is also saving about $400 a year in power. The bus does not hold as many passengers as an electric car, but has ample capacity for the traffic.

The single motor drives the two rear wheels by means of a longitudinal shaft, connected by bevel gears to a jack shaft with differential gear, which in turn is connected with the rear wheels by chains, the method of connection being very similar to that employed in an ordinary automobile truck. Solid rubber tires are used. Connection is made to the two overhead trolley wires by means of two separate trolley poles with swiveled harps and bases. The poles are extra long to give a lateral freedom of movement of 10 feet to 12 feet on both sides of the trolley wire. This prevents interference with the bus from other street traffic. The two trolley wires used by the bus are fed from the two trolley wires of the local railway system, which is equipped with a complete metallic circuit.

The operating expenses per car-mile are estimated as follows: Management, salaries, and wages, 3.2 cents; electric power, 4.85 cents per watt hour, or 1.6 cents; tire renewals, 3.4 cents; maintenance, 1.8 cents; total, 10 cents. The main dimensions of the bus are: Length over all, 18 feet 6 inches; width, 6 feet; height in passenger compartment, 6 feet 8 inches. The weight empty is about 3 tons.

Express and interurban cars.—Various new departures and experiments in both classes have been made, altogether too numerous to specify. It must suffice to select one or two examples. The Northwestern Pennsylvania Railway, for instance, has developed and put in use a combination parlor car, smoker, and baggage coach, operated in a train for "limited" service between Erie and Meadville, Pa. The arrangement is unusual in that the two cars operate with the passenger entrance in the center of the train only. The combination car is placed at the front end of the train. Each car is 50 feet 10¼ inches long over the buffers, 49 feet 6¼ inches long over the vestibules, 39 feet 6¾ inches long over the end plates, 9 feet 4 inches high from sill to top of roof, 8 feet 6 inches wide over all, and 8 feet 2 inches wide over the sills. The distance between the center lines of the bolsters is 27 feet 9 inches, and the wheel base of the trucks is 6 feet 6 inches.

While a center-entrance train is not altogether new, there is novelty in the car plans. The baggage and express section of the combination car is furnished with a sliding door of 4-foot opening on each side and with folding slat seats. The motorman's cab, which is placed at the right-hand side, is provided with a 20¾-inch inside swing door and a 31-inch swing door to cover the front entrance to the car. A space between the smoker's compartment and the baggage compartment is reserved for the heater, the toilet room, and lockers for the crew, card tables, etc. The passengers' platform at the rear is provided with a 31-inch swing door on each side.

The second car of the train has a front platform which is similar to the rear platform of the combination car. The rest of the car, however, is divided by partitions with center doors into a section with cross seats designated as the ladies' compartment, a section with individual chairs called the parlor compartment, and finally a smokers' section de luxe at the rear. The seats in this smaller smoking compartment are removable, so that the platform may be used for operation if desired. All seats are upholstered in crimson plush. An extra fare is charged for the use of the parlor compartment and the smoking section which adjoins it.

As to freight or express cars, attention may be drawn to those put in operation in 1913 by the Bay State

Street Railway of Boston, Mass., for use on the through lines of the company between its Boston freight and express terminals and points in southern Massachusetts and Rhode Island. The new cars represent a striking advance in rolling stock built for this class of service, and are said to be the lightest-weight express cars of their capacity thus far developed. These cars are of the double-truck, flush-platform type, with side and end doors, steel underframing, and semisteel body. The general dimensions are as follows:

Total length over bumpers, 39 feet.
Length between screen bulkhead partitions, 30 feet.
Width over side plate, 8 feet.
Total width over all, 8 feet 2 inches.
Height from rail to top of floor, 46 inches.
Height from rail to top of trolley board, 11 feet 9 inches.
Distance between truck centers, 22 feet.
Wheel base of trucks, 6 feet 4 inches.
Wheel diameters, 34 inches.

The carrying capacity is 20 tons, and the total weight of the car equipped, but without load, is 45,800 pounds. This represents a saving of more than 4,000 pounds in weight in comparison with the earlier express cars used by the road.

New funeral trolley cars.—Cars of this type have been previously described, and there are several in operation. The Philadelphia Rapid Transit Co. placed in commission in 1912 a special funeral car, which may be chartered for transporting funeral parties to any of the many cemeteries reached by the company's lines. The car is named "Hillside," after one of the cemeteries in the suburbs of Philadelphia on the Glenside line. It seats 40 persons in the main compartment and 6 persons in the pallbearers' compartment. A few additional seats are provided by the use of camp stools. The coffin is carried in an inclosed cabinet or vault occupying a portion of the pallbearers' compartment. The coffin is placed in this vault from the outside by lowering a section of the panel in the side of the car, which is hinged at the lower edge for this purpose. To the inside of the two upper corners of the hinged panel are attached chains which pull against automatic equalizers such as are used for operating Pullman berths. This counterbalancing device facilitates the raising and lowering of the panel and also serves to hold the panel in the open position. When the coffin is to be placed within the cabinet, the hinged panel is swung downward to a horizontal position, where the chains hold it at right angles to the side of the car. On the floor of the cabinet is a movable platform mounted on rollers, which is drawn out from the cabinet on to the shelf formed by the lowered panel. The coffin is then placed on this platform, and the platform and coffin are pushed back within the cabinet without jar or friction. When the panel is raised into place, the coffin is concealed from view. The panel is securely fastened by means of two locks operated by handles on the outside. The top of the coffin cabinet is about 3 feet above the floor in the pallbearers' compartment and forms a suitable place for displaying floral emblems.

For convenience in conveying the coffin from the residence or church to the car, a small, rubber-tired, collapsible truck is provided, which makes it possible to move the coffin over the sidewalk or street with no inconvenience or undue effort on the part of the pallbearers. The truck is folded into a small case and is carried on the car, it being also used at the cemetery for transferring the coffin from the car to the grave. By the use of this truck it is entirely feasible to move the coffin a block or two in order to reach the car line.

The car is appropriately finished and decorated. The exterior is in green, with lettering and striping in gold. The interior is in mahogany, with the ceiling in a lighter green decorated in gold leaf. The windows are draped with heavy black velours. The seats are finished in black Spanish leather. All metal trimmings are oxidized. The effect as a whole is one of dignified beauty and impressiveness, thoroughly in keeping with the use for which the car is intended.

To insure thorough sanitary conditions, the car is cleaned and fumigated after every trip. An iced-water tank is located in the pallbearers' compartment, and the company provides iced water and free sanitary drinking cups.

The car has rolled-steel driving wheels and cast-iron pony wheels. The car body is equipped with two 60-horsepower motors. The weight complete is about 39,000 pounds.

General car outlook in 1912.—While the census reports present in general the aggregate figures which represent the development of the industry at the end of any given period, it is interesting to learn the statistics and data for any given year. Figures compiled by the Electric Railway Journal for 1912 thus indicate that the total number of all new cars ordered in 1912 in the United States and Canada was 6,001, an increase of 1,986, or 49.4 per cent, over 1911. Every effort was made to secure returns, and those from car builders were checked up against those from railway companies; but a few companies did not reply in time to permit the inclusion of their data. The number of cars ordered, classified according to the service in which they are used, is given below:

	1912	1911	1910	1909	1908
Total	6,001	4,015	5,381	4,957	3,111
Passenger cars, city	4,531	2,884	3,571	2,537	2,208
Passenger cars, interurban	783	626	990	1,245	727
Freight and miscellaneous cars	687	505	820	1,175	176

A great many city cars ordered during 1912 were of the prepayment type. A special enumeration is not made of the prepayment cars, because this type is now almost universal in new city cars.

Interurban passenger cars showed an increase of 25.1 per cent over the totals of 1911. The figures for interurban cars include orders for subway and elevated equipment.

Among the striking features of rolling-stock orders in the year was the increase in the use of the near side car. Of this type the Philadelphia Rapid Transit Co. ordered 950 cars; the International Railway, Buffalo, 316 cars; and the Chicago City Railway, 125 cars. The one-man near-side car was also developed. Cars of this type were ordered by the International Railway, the Illinois Traction System, and the Fort Wayne & Northern Indiana Traction Co. Another striking development in rolling stock was the introduction of the center-entrance car. Large orders of this type included one from Brooklyn for 100 cars, one from New York City for 175 cars, and one from Los Angeles for 36 cars.

In addition to the rolling stock listed, there were large sales of gasoline-motor, gasoline-electric, and storage-battery cars for branch lines and suburban service on steam railroads. The facts relating to these will now be presented as a subdivision of the general subject of cars.

Advances in self-propelled cars.

Storage-battery cars.—These cars have come into notable use again, and various types have been adopted during the last few years in different cities and for various classes of service. Batteries of the steel-nickel or lead-lead "plates" are employed, and the cars themselves exhibit a great variety of style and feature.

Three cars of the La Jolla line of the Los Angeles & San Diego Beach Railway are 40 feet long over all, 29 feet 6 inches over the corner posts, and owing to the extraordinary width of 10 feet 4 inches, every one of the 24 cross seats is wide enough for three passengers. The motorman's cabs, in diagonally opposite corners, are separated by a bulkhead and door from the passenger compartment. The operating equipment consists of 202 steel-nickel cells, 10 lighting and control cells, 4 200-volt, 75-ampere motors operated at 700 revolutions per minute, multiple-unit control, and straight and automatic air brakes. The trucks are of M. C. B. pattern, and M. C. B. couplers are used. The combination passenger and baggage car of the St. Joseph Valley Traction Co., Elkhart, Ind., is 52 feet over all, 9 feet 4 inches wide, and is mounted on two M. C. B. trucks of 6-foot wheel base. The main and smoking compartments have plush-covered reversible seats, while the baggage compartment has folding benches. The electrical equipment comprises 225 steel-nickel cells for traction, five like cells for lighting, four motors of the type and capacity used on the La Jolla cars, air brakes, and series-parallel control. An earlier car of this type, furnished with 220 cells for traction and 7 like cells for lighting, has been furnished to the Lorain, Ashland & Southern Railway for service between Lorain and Ashland, Ohio, the road having formerly used gasoline cars. A third combination car, fitted with 225 and 5 traction and lighting cells, respectively, has also been ordered.

The Panama Tramways Co. has ordered 15 cars equipped with both storage batteries and overhead trolley. Among the notable features of these cars are the use of a truck with 7-foot 6-inch wheel base, and operation as prepayment cars. The cars are 20 feet 6 inches long over the posts, 30 feet 2 inches long over all, and 8 feet wide over all. The single-arch roof used is fitted with four ventilators. The car seats 32 in 14 cross seats and 4 corner seats. The cross seats are 33 inches wide, with a 22-inch aisle between them. The electrical equipment per car comprises four motors and two controllers.

The Lewisburg, Milton & Watsontown Passenger Railway Co. has been operating with storage batteries of the lead-lead type since the summer of 1911 over approximately 11 miles of track on the Lewisburg and Tyrone Branch of the Pennsylvania Railroad between Montandon and Mifflinburg, Pa. This company first acquired trackage rights from the Pennsylvania Railroad from Montandon to Lewisburg, Pa., a distance of approximately 1½ miles, including a bridge across the Susquehanna River, in order to connect Lewisburg by trolley cars with Milton and Watsontown. There being a demand for additional local service between Lewisburg and Mifflinburg, which, while very material, did not justify the operation of steam trains by the Pennsylvania Railroad or the expenditure of the necessary capital to install overhead trolley wires, the company was able to extend its trackage agreement with the Pennsylvania Railroad to cover the distance of approximately 9 miles between those places, and to place in service a storage-battery car, which is operated between steam trains on a schedule published in the Pennsylvania Railroad time-table. Movements of the storage-battery car are subject to orders from controlling signalmen of the Pennsylvania Railroad. The car makes five round trips between Montandon and Mifflinburg and three round trips between Montandon and Lewisburg, a total of about 122 miles per day.

A storage-battery car of unusually large size was put in operation at the close of 1912 in the service of handling local passenger and express traffic on a branch of the Chicago Great Western Railway which had been previously operated by steam locomotives. On account of the requirements of the service for which the car is intended, the body has been divided into three compartments, of which one is for baggage and express, another for smokers, and the third, or largest, is arranged like a standard passenger coach.

This car is 49 feet 8½ inches long over drawbar, 9 feet 1 inch wide over drip rail, and 12 feet 6 inches from rail to top of ventilators. It is equipped with 220 nickel-steel alkaline cells for power and ten cells for light. These batteries are placed under the car in two compartments, strongly reinforced with structural shapes and riveted to the underframe. They are of special railway type, having 3 inches of water over the plates. The car is equipped with four 20-horsepower, 75-ampere, 200-volt, series-wound motors, with a speed of 720 revolutions per minute. Two of these are placed on each truck, one on each axle. The axles are stationary and one wheel on each axle is driven by a gear fastened to the inside of the hub, the ratio of reduction being 3.5:1. There are two series-parallel controllers, one on each end of the car, with four series and three parallel positions. All power wires are carried in conduit securely fastened to the underframe. The car is equipped with M. C. B. couplers of standard height of drawbar, locomotive type of pilot on each end, a locomotive bell, and an electric horn. The equipment includes a straight-air system of air brakes with a compressor which automatically cuts in when the pressure drops to 45 pounds and cuts out when the pressure reaches 60 pounds. Hand brakes are also furnished at both ends of the car.

The underframe is made up entirely of structural shapes, riveted together and strengthened with truss rods on each side. The interior finish is of ash and polished bronze in the passenger compartment, which is 22 feet long. This has 10 cross reversible seats, seating two passengers each, two stationary cross seats for two passengers each, and two longitudinal seats with space for one and three passengers, respectively. The seats are covered with woven rattan, and have the usual bronze grab handles. In this compartment is a toilet room with a dry closet and a water cooler. The smoking compartment is 5 feet 3 inches long, and has four stationary cross seats for two passengers each, the total seating capacity of the car being 36 passengers. The baggage and express compartment is 15 feet 6 inches long, with sliding doors on each side. A hot-water heater is placed in it and from the heater pipes run through the other compartments.

The trucks are of diamond-frame type, and while of light construction are exceptionally strong. The wheels are chilled iron, and they are free to rotate independently of each other on the stationary axles. This is accomplished by pressing on to each end of the axle a nickel-steel hardened sleeve over which two trains of rollers rotate. The rollers in turn are held in a nickel-steel hardened raceway pressed into the wide hub of the wheel.

A maximum speed of 35.6 miles per hour on level track and 29.6 miles per hour on a 2 per cent grade has been attained with an energy consumption reported at 30.4 watt hours per ton-mile in the former case and 46.3 watt hours per ton-mile in the latter. The car, including the battery, weighs 29.5 tons, and its train resistance is stated to be 15.2 pounds per ton and 24.7 pounds per ton, respectively, for the level and for the 2 per cent grade. While the radius of action of the car on the rated capacity of the batteries is 79 miles, the actual radius has been found to be 89 miles, and on an overcharge the maximum output of the batteries will permit the car to be operated for 100 miles.

A further development of the storage-battery car has been its use on the New York Railways of New York City in the stepless form, with a single truck. These cars were introduced at the end of 1912, and have a wheel arrangement similar to that of a single-truck car. No truck is used, however, the body being spring-supported directly on the journal boxes. The use of only two axles with small wheels has enabled the designers to bring the points of support near together and by means of a novel motor drive has permitted the body to be carried practically above the axles instead of hanging between them as in the original double-truck stepless car. However, the feature of a single 10-inch step from the street to the car floor has been retained, as well as the fare-collecting arrangement in which the conductor is stationed behind a change desk opposite the entrance door.

The exterior features include a single-arch roof, with upward sweep of the eaves at the ends of the car, permitting front windows of a greater height than at the sides. There are low-entrance doors at the sides of the car, but the lower side panel below a heavy belt rail is concave for wagon-hub clearance on account of the narrow streets in which the car is operated.

The interior has, in general, a longitudinal seating arrangement. There are, however, two stationary cross seats, one in each half of the car, on opposite sides, so that they are almost diagonally across the car from each other. Under these stationary cross seats are located the motors. Owing to the ramp which rises from the low center portion of the car at the doors toward the higher end floors, the longitudinal seats near the ends are at a higher elevation than those near the center in order to give seats with level tops without too great a height above the car flooring. Under the longitudinal seats are the storage batteries, the entire space thus afforded being used for this purpose except short sections in which are located the heaters and motorman's space. Based on a 17-inch allowance for each passenger, the seating capacity of the car is 34. All of the seats are covered with rattan, and in general are 16½ inches wide at the hip line.

Separate compartments are not provided for the motorman, and the entire rear end of the car is in consequence available for seated passengers, the controller being covered when not in use by a swinging section of the seat back near the center portion of each end of the car. At the operating end a removable section of the seat is drawn out of place, turned around, and reinserted in the horizontal slides in which it moves, thus forming a seat with a back for the motorman. When turned around in this manner the seat is pushed in only part way, so that room is provided for the motorman's knees sufficient to allow him to operate the foot brake. The brake is of the automobile type with pedals at the extreme ends of the car, which are consequently concealed by the seats when these are in the position for use by passengers. The arrangement eliminates the necessity for a bulky brake wheel or ratchet handle likely to interfere with the convenience of passengers or reduce valuable seating space. Roller curtains are provided at the motorman's sides and back in order to protect him against the glare from the interior when the car is lighted at night and to isolate him from the passengers. These curtains are carried on rollers attached to the ceiling and roll up out of the way when not in use. They are guided by enameled stanchions.

The main-entrance doors are of the folding type. Owing to the small seating capacity the door width is only 25 inches, this being considered ample for the service in which the car is used. This gives room for only a single file of passengers, but it provides extra seating capacity and also permits the use of a single folding door which can be operated manually by the conductor, thus eliminating the weight of an operating mechanism as well as the necessity for compressed air, which on this car is not needed for the brakes. The operating mechanism is a simple bell crank attached to the door and connected under the floor by a rod to an operating crank at the opposite side of the car from the entrance. This position of the operating crank permits the conductor to be located in the same position in which he is in the original stepless car and yet enables him to operate the door without moving from his position. The car body is built up on a structural-steel underframe, to the side sills of which is riveted steel-plate side sheathing extending as high as the belt rail for the entire length of the car.

The general dimensions and weights are as follows:

Length over all, 28 feet 9 inches.
Height over all, 8 feet 8 inches.
Width at sills, 6 feet 7 inches.
Greatest width at belt rails, 7 feet 9¼ inches.
Wheel base of single truck, 7 feet 6 inches.
Slope of ramp in floor, 6 inches in 8 feet 6 inches.
Diameter of wheels, 21 inches.
Height of step from street, 10 inches.
Seating capacity, 34 17-inch seats.
Weight of car complete, 16,500 pounds.
Weight of battery, 4,300 pounds.
Weight of car without battery, 12,200 pounds.

The weight of the car, including the battery as it stands, is 485 pounds per seated passenger, or for the car alone without the battery only 360 pounds per seated passenger.

The drive is unquestionably one of the most interesting of all of the original features of this car. The two motors are located under the two transverse seats diagonally opposite to each other. Each motor rests on the bottom framing over a space formed by a longitudinal I-beam along the center line of the car, two of the needle beams, and the side sill. Below the motor is a back gear shaft supported in bearings attached to the underside of the framing. On this back gear shaft, which is driven by a gear meshing with the motor pinion, is a sprocket wheel from which a slow-speed roller chain drives another sprocket on the car axle, the latter sprocket being located just outside of the wheel. The wheels are 2 feet 3½ inches nearer to the center line of the car than the motors, and the chain drive is practically horizontal, thus permitting vertical motion of the wheel between the pedestals independently of the motor supported on the car body. The wheels are pressed on to the axles and in consequence those on either axle can not revolve independently of each other. The drive provides for 100 per cent of the weight upon the traction wheels.

The two motors are of double-reduction gear, rated at 85 volts and 40 amperes, with a speed of 1,400 revolutions per minute. The gear reduction is 6 to 1, the first reduction being obtained by the back gear shaft and amounting to 4.8 to 1, and the second reduction resulting from the difference in the sizes of the two sprockets for the slow-speed roller chain and amounting to 1.25 to 1. At their rated capacity the motors deliver about 4 horsepower each. The batteries, which are located under the car seats, are of the lead-lead type. There are 44 cells, each of which provides an initial voltage of 2.1 and a final voltage when near discharge of 1.7. The rated capacity of the complete battery is 86.4 amperes for four hours, giving approximately 29,000 watt hours available on a normal charge.

Efforts have been made to introduce storage-battery cars for lighter traffic on main lines of railroad, although so far no great headway has been made in that direction. On March 6, 1913, for example, a car equipped with nickel-steel batteries made the run from New York to Boston via the New York Central Railroad from New York to Albany and via the Boston and Albany Railroad from Albany to Boston, a distance of about 307 miles.[1] This car is 49 feet 8½ inches long over drawbar, 9 feet 1 inch over drip rail, and 12 feet 6 inches from rail to top of ventilators. It is equipped with 225 cells of nickel-steel alkaline batteries for power and five cells for light. These batteries are placed under the car in two compartments strongly reinforced with structural shapes and riveted to the underframe. The car is equipped with four 20-horsepower, 75-ampere, 200-volt, series-wound motors. The wheels are driven by gears placed on the inside exterior of the hubs, the ratio of reduction being 2.5:1. There are two series-parallel controllers, one on each end of the car, with four series and three parallel positions. All power wires are carried in conduit securely fastened to the underframe. This car is equipped with M. C. B. couplers and standard height of drawbar, locomotive type of pilot at each end, and air whistle at each end It is also equipped with a straight air-brake system. using a motor-driven compressor. The interior finish is of ash and polished bronze. The body is divided into two compartments, passenger and baggage. The passenger compartment is 30 feet 2 inches long, with 16 cross reversible seats, two stationary cross seats, and two longitudinal, seating one and three passengers, respectively. The baggage compartment is 11 feet 10 inches long, with sliding door on either side. The total seating capacity of the car is 51 passengers.

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[1] Electric Traction, April, 1913.

The trucks are of a modified diamond-frame type and are made up of standard shapes and flat plates. The wheels are chilled iron, 33 inches in diameter, and are free to rotate independently of each other on the stationary axle. The truck pedestal springs are double coil, while the body springs are double elliptic.

The car without battery and passengers weighs 48,235 pounds; standard battery, 8,525 pounds; auxiliary battery, 8,525 pounds; light battery, 266 pounds; accessories on car, 500 pounds.

The table herewith contains some interesting information regarding the car and the trip which it made from New York to Boston.

Condensed Report, New York-to-Boston Run, March 6, 1913.

Actual running time, 11 hours 6 minutes 51 seconds (11.115 hours).
Total distance (from time-table), 306.71 miles.
Average miles per hour, 27.6.
Total number of kilowatt hours, 369.1.
Average kilowatt hours per car-mile, 1.2.
Total ampere hours, 1,303.
Average ampere hours per car-mile, 4.25.
Average ampere hours per ton-mile, 124.
Average voltage, calculated from ampere hour and kilowatt hour, 283.
Maximum speed, 42 miles per hour.
Average of accelerating current, 203.7 amperes.
Total charging time on run, 3 hours 27 minutes (3.45 hours).
Total ampere hours from charging, 973.
Average charging current, 353 amperes.
Average charging voltage, 429.
Total kilowatt hours charging, 522.

Weather conditions: Rain from Grand Central Station to Poughkeepsie; light snow from Poughkeepsie to Hudson; heavy snow from Hudson to Chatham; high cross wind and drifting snow from Chatham to Springfield; 6° above zero from Springfield to Boston.

Gasoline and gas-electric cars.—The gasoline car, as such, has never been regarded as likely to become available in ordinary street railway service, although a place has been found for it in interurban work, and, of course, more particularly on parts or branches of steam railroads. The makers of one leading type of gasoline car for track service, with mechanical drive, reported that in April, 1913, some 138 were in use on 50 different railroads in the United States and foreign countries. Other makes were also in use but not in any considerable number in America. Of recent years a good deal of attention has been given to gasoline cars with electric drive, in which the engine operates an electric generator, whose current is transmitted to electric motors geared to the driving axles, instead of the engine being connected to the axles by mechanical gearing. The work in this field has been done chiefly by one large electrical manufacturer and has resulted in the production of a type that is in use on several branch and interurban lines. Sixty of these cars are reported as in regular daily service, of which 12 were on the "Dan Patch" line of the Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Co. At the fifth annual meeting of the International Railway Fuel Association in Chicago, in May, 1913, Messrs. S. T. Dodd and B. H. Arnold presented data as to operating conditions and results with such cars on the Frisco lines and the "Dan Patch" lines. The table for the latter is given herewith as an example of performance on an interurban line with a very fast schedule. The trailers hauled consisted of a mixture of passenger, freight, and work cars. The cost of heating, supplies, and maintenance of equipment included also the cost for these trailers. The longest maximum grade of 1.5 per cent is about 2 miles, and there is one stretch where the grade averages 1.37 per cent for a distance in excess of 4 miles. In addition to the station stops, there are two compulsory stops at railroad crossings at grade and one drawbridge stop.

"Dan Patch" Line—Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Co.—Cost of Operating Gas-Electric Motor Cars from Jan. 1 to Aug. 31, 1912.

Motor car-miles, 216,498; trailer car-miles, 75,948; total car-miles, 292,446.
Per cent of time trailers hauled, 35.5.
Number of motor cars in service, 8.
Length of line, miles, 37.34.
Maximum grade, per cent, 1.5.
Schedule time for express trains, 1 hour and 17 minutes.
Average distance between stops for express trains, miles, 3.734.
Schedule speed of express trains, miles per hour, 29.1.
Schedule time for local trains, 1 hour and 35 minutes.
Average distance between flag stops for local trains, miles, 1.067.
Schedule speed of local trains, miles per hour, 23.6.
Gallons fuel used per motor train-mile, 0.758.
Gallons fuel used per car-mile, 0.527.

	Cost for one year.	Average cost per motor train-mile.	Average cost per car-mile.
		Cents.	*Cents.*
Total	$39,139.71	18.08	13.38
Wages of crew	12,056.95	5.57	4.12
Fuel (naphtha)	17,622.26	8.14	6.03
Lubrication (gas engine)	1,141.56	0.52	0.39
Journal oil	77.77	0.04	0.03
Supplies and car heating	1,389.03	0.64	0.47
Maintenance of electrical equipment	1,949.81	0.90	0.67
Maintenance of cars and trucks	1,394.56	0.65	0.47
Shop expense of heating	3,507.77	1.62	1.20

In the latest cars of the gasoline-electric type, the car body is built of steel and is designed for the greatest lightness and strength. The front end of the car is rounded to reduce train resistance to a minimum when operating at high speeds. Either center or rear entrance is provided to meet the requirements of traffic in various localities. The cars are built in lengths running from 40 to 70 feet over all, and weigh from 40 to 50 tons complete. The interior of the car is subdivided into passenger, smoker or second-class, baggage, and engine room. The width of the car is 10 feet over all, full advantage having been taken of standard steam railroad clearances, and the cars have a seating capacity which may run as high as 95 or 100 passengers per car, depending upon the interior arrangement.

The power plant in the engine room at the front end of the car consists of an 8-cylinder, 4-cycle gas engine with a speed of 550 revolutions per minute, direct-connected to a 100-kilowatt, direct-current generator. The generator is built essentially to meet motor-car service and is therefore designed for a wide range of current or voltage, so that the output may be varied from 400 amperes at 250 volts to 125 amperes at 800 volts.

The trucks are of an equalized, swing-bolster type, suitable for the high speeds obtainable with this type of car. One, the motor truck, is designed for carrying two driving motors. The other is a standard light-trailer truck. The motor truck is generally placed under the forward end of the car and carries the weight of the engine-room equipment in addition to the motors. In such a case as this, about 60 per cent of the weight of the car is on the driving wheels. In some cases, however, the motor truck has been placed at the rear end of the car, under the passenger compartment, and under this condition approximately 50 per cent of the weight of the car is on the drivers.

The car is equipped with two 100-horsepower railway motors. These are commutating-pole motors and are suited for wide variation in operating voltage. The gearing is specially selected for the service. The gear ratio is low enough so that the highest maximum car speed will not develop excessive rotative speed of the armatures; at the same time it is high enough to obtain the requisite starting effort without imposing excessive overloads on the motors. The car is designed for operation from one end only. The engineer's seat is located at the righ-hand front window of the engine room, and controller and throttle handles are placed directly in front of him. The controller is a convenient combination of engine and generator control, with the different levers placed vertically above each other and operating at practically the same center line. The highest of these levers is the throttle lever, which controls the supply of gas to the engine, and as a consequence the speed and power of the engine. Directly beneath this is the electric-control handle. On the first part of the range of this handle the two motors are connected in series, and the whole current of the generator passes through each of them. Successive steps raise the generator voltage from about 250 volts on the first step to about 700 volts on the seventh step. By moving the controller, to the next step the voltage is reduced to about 250 volts, and at the same time the connection between the motors is changed, putting them in multiple with each other. On the remaining steps the two motors are running multiple, dividing the generator current between them, and each actuated by the full generator voltage. This voltage is raised in successive steps up to a maximum of about 800 volts on the thirteenth step. Two final steps, in addition to this, are suitable for particularly high speeds on level track.

The engine-generator set is started by admitting compressed air to the cylinders. This is done automatically on the first opening of the throttle. As soon as the engine turns over, and the first charge of mixture is exploded in the cylinder, the air is automatically shut off. Air reservoirs, which supply air for the brakes and whistle and for starting the engine, are charged by an air compressor driven from the main crank shaft of the engine. A small independent engine-generator set is supplied for furnishing the lights, and a separate compressor connected to this engine is used for charging the reservoirs in case they are entirely empty.

In Europe the most extensive experience with electric-drive gasoline cars has been on the Arad-Csanad Railway in Hungary. This road has been operating gasoline cars since 1905. At the present time, the cars are running approximately 1,000,000 car-miles per annum, and have a total record of over 5,000,000 car-miles. This road's records of cost of operation and maintenance of such equipment are probably more complete and extensive than those of any other railroad, and show an average cost of maintenance of 2.5 to 3 cents per car-mile. These cars have recently been introduced into this country, and several are already in use. The car is 56 feet long over bumpers and 9 feet 6 inches in width, and is divided into first-class, second-class, engine, and baggage-room compartments.

Center-entrance cars.

The center-entrance car seems to have made a very distinct place for itself during the period 1907–1912, but is still in its earlier stages as to the determination of standard features. This may be seen from a consideration of some of the types thus far evolved and put into service. Certainly among the most notable of these is the "stepless" or low-step class.

New types in Cleveland.—In 1913 the Cleveland (Ohio) Railway Co. added 50 new center-entrance motor cars to its equipment, which represent a marked departure from the center-entrance trail cars put in operation by this company in the fall of 1912. While the same effort was not made in designing these new cars to obtain a low floor in the seating space, attention was directed to the height of the first step from the pavement, which, as a result, was reduced from 15 inches to $12\frac{11}{16}$ inches. The over-all length of these new cars is 2 feet more than that of the trail cars, which additional length was not enough to provide for the motorman's cab in one end of the body. Partly for this reason the seating capacity was reduced from 65 passengers in the trail car to 59 in the motor car. This reduction in seating capacity is also accounted for in part by the additional width required in the entrance well because of the new arrangement of entrance and exit doors. The low-step height from the top of the rail to the entrance well also made it necessary to provide two steps from the well to the car-floor level. These motor cars are operated either singly or in two-car trains, and are provided with four motors of sufficient capacity to pull trailers. Their principal dimensions are as follows:

Length over all, 51 feet.
Length of body, 50 feet.
Truck centers, 26 feet.
Wheel base, 5 feet 6 inches.
Step heights, $12\frac{1}{16}$ inches, 12 inches, $7\frac{5}{16}$ inches.
Floor to top rail, 2 feet 8 inches.
Width over side plates, 8 feet 2 inches.
Width over sash rail, 8 feet $4\frac{3}{4}$ inches.
Height inside, 8 feet.
Height at entrance, 9 feet $7\frac{5}{16}$ inches.
Passengers seated, summer, 59.
Passengers seated, winter, 58.
Passengers standing, 65.
Standing room in entrance well, 20.
Wheel diameter, 26 inches.
Total weight of complete car, 44,280 pounds.

The design provides for a single-end, center-entrance, low-step, arched-roof car body, built with an all-steel underframe and side girders, and a composite body and roof framing. The side framing up to the sash rail is formed of a plate girder extending around the entire car body from one side of the center-entrance doors to the other. The body bolsters of these cars are of special design, and are built up of two pressed-steel plate channels to form the web members to which the top and bottom cover plates are securely riveted. The channels are formed of $\frac{1}{2}$-inch steel plates with holes punched from the webs to reduce the weight. The top and bottom plates are $\frac{3}{8}$ inch thick and 9 inches wide. At each end of the side girders which terminate at the corner posts the latter are made continuous across the car, forming both corner posts and roof carlines. These are constructed of two 2-inch by 2-inch by $\frac{3}{16}$-inch angles.

The method of ventilation adopted as standard by the Cleveland Railway Co. on all plain arched-roof cars is also used. A small ventilating louver, running the full length of the car body, is supported on aluminum brackets with louvers at the sides, allowing air currents to play through from all directions, creating a suction over ducts coming up through the roof under the small ventilating-louver deck. The brackets are reinforced at the place where the trolley stand and base are supported. Thirteen ducts leading from the inside of the car to the roof under the ventilating louver are covered on the under side of the head lining by neat polished-bronze registers. These roof openings are placed in the center of the ceiling, running longitudinally. With this system it is impossible for snow, sleet, or rain to reach the interior of the car.

Eighteen windows are provided on the "devil-strip" side of the car body and 14 on the entrance side. These, as well as the three windows in the rear end of the car and the two windows in the motorman's cab, are single sashes arranged to drop into pockets between the window posts. All sashes are made $\frac{5}{8}$ inch thick with brass stiles and cherry rails.

The entrance and exit doors at the center of the car are built of 1-inch solid cherry with two glass panels and brass wearing strips. These doors are equipped with ball-bearing door hangers and are operated electropneumatically by a push button set in the fare-box stand convenient to the conductor. These doors slide into parallel pockets provided in the panel between them. A natural red-cherry wood finish, slightly stained to insure a uniform color, is used in all interior panelings and moldings. The latter are free of all corners liable to collect dust and dirt.

The car is designed for single-end operation; consequently the rear vestibule is available for seating space at all times, and the motorman's cab is permanently in the front vestibule. The cab occupies a maximum width of 3 feet 2 inches. The seating arrangement for passengers is somewhat different from that in general use, being a combination of cross and longitudinal seats. The cross seats have pressed-steel pedestals. Six cross seats occupy each end of the car body, with longitudinal seats encircling the rear vestibule and extending the full length of the "devil-strip" side of the car. The location of the conductor's stand in the entrance well makes it possible to utilize the opposite side of the car at this point for seating space. A longitudinal seat has been installed in the well with a removable panel at one end to provide for the forced hot-air heater during the winter months. By this arrangement provision was made for a maximum seated load of 59 passengers and a total seated and standing load of 144 passengers. In order to improve conditions for standing passengers, a continuous handrail supported on brackets 5 feet 11 inches above the floor runs the full length of the car on the longitudinal-seat side. Pipe stanchions are also provided on each side of the aisle at the break between the car-body floor level and the entrance well.

At the time the mechanical department was considering the design of these cars, this company had already adopted the method of fare collection in which a combination pay-as-you-enter, and pay-as-you-leave principle was used. In the center-entrance trail car, however, the conductor stood opposite the center-entrance doors in the center of the car body. Hence he blocked the center aisle, and it was also necessary that he stand with his back to one end of the car. In the new motor cars the conductor stands with his back to the panel between the center-entrance doors, which permits him not only to clear the entrance aisle but to observe passengers in both ends of the car body. In operating this car with the combination system of fare collection the conductor collects fares from passengers entering one end of the car and from those leaving the opposite end of the car. The conductor's stand is mounted on a slightly elevated platform, which protects him not only from the accumulations of snow and moisture in the entrance well during bad weather but also against being crowded away from his station by passengers. This method of fare collection was adopted in order to relieve congestion in the downtown district during the evening rush hours and has been found to work quite satisfactorily.

The system of illuminating these new cars was adopted as a result of an exhaustive test in car illumination made by the Cleveland Railway Co. during 1911 and 1912. In this test the illuminating system which gave the highest efficiency was furnished by five 100-watt tungsten "Mazda" lamps in satin-finish reflectors mounted in special shade holders. These lamps were in series and were mounted on the ceiling along the center line of the car, and a spare lamp was so connected with a selector switch that it could be instantly cut into the circuit in case of failure of any one of the five lamps regularly lighted. In the new cars, however, 92-watt lamps securely fastened in electric pendants and provided with deep reflectors were installed. Five of these lamps were spaced uniformly along the center line of the car ceiling with the spare lamp beside the one over the entrance well. The selector switch was placed in the panel just back of the conductor's stand.

In addition to the usual buzzer system installed with push buttons at convenient locations on the posts between the windows, a light signal was provided. The signal circuits were so arranged that the signal lamps in the motorman's cab indicate the position—open or closed—of the center-entrance doors in addition to showing the signals operated by means of the conductor's push button. Both the signal and lighting systems were also arranged for trailer operation, a coupler socket and drum switch being provided just inside the rear buffer.

The brake apparatus of these center-entrance motor cars is novel in that two 8-inch by 8-inch air cylinders were employed, one operating the brakes on each truck, although the hand brake operates on both trucks. A single lever having equal arms was used with one end connected to the push rod of the cylinder and the other end to the truck-brake pull rod. The two cylinders were in turn connected by an air pipe to insure uniform pressure on both pistons and consequently equal brake power on both trucks. The brake cylinders were placed horizontally against the large 12-inch channels each side of the center-entrance well and were hung from the steel underframing in forged-steel stirrups.

A hand-brake system was installed, with the usual drop-handle brake staff on the step side of the motorman's cab. The hand-brake rod was hung below the step side and side sill and extended to a long lever operating in a horizontal plane and placed just in front of the center-entrance well. The other end of this lever was connected in turn to an extension of the forward lever of the air-brake apparatus by a slotted link. From this connection a cable was carried under the center-entrance well and connected to the pull rod of the rear-truck brake.

A commutating-pole type of motor having the following characteristics was adopted: Forty horsepower on one-hour rating; gear ratio, 57:15; and to operate on 26-inch wheels. It was the aim of the railway and the manufacturers to produce a motor which could be adapted to a 26-inch wheel.

The trucks are of special design. They were constructed to be equipped with two motors each and to operate with 26-inch, one-wear, rolled-steel wheels on axles of 4½-inch diameter at the motor bearings and 5-inch diameter at the gear seat and with the railway standard 3¾-inch by 8-inch journals. Roller side bearings and ball center bearings were also included. The wheel base of the truck is 4 feet 10 inches, and the height from the rail to the top of the complete center plate is 21 inches with the car body in place.

New types in Pittsburgh.—After experimenting for a period of nearly two years, the Pittsburgh Railways Co. has adopted as standard a type of center-entrance car that possesses many unusual features. Foremost among these are the small motors and wheels that permit the car floor to be kept down to a point which in the center of the car is only 24¾ inches above the rail. Another feature is the use of a front exit as an auxiliary to the center doors with which the car is furnished. This makes a compromise type, because the two doors at the center are not used to provide a separate exit and entrance, but are flexible in their use, so that, if desired, both may be used as an entrance or both as an exit. There is no definitely assigned path for the movement of passengers in and out of the car, the conductor directing this in accordance with the immediate needs.

This radical departure from the usual custom of handling passengers along rigidly prescribed lines is stated to have been adopted on account of the peculiar conditions existing in Pittsburgh. In that city it is customary, on outgoing cars during the rush hour, for all passengers to be loaded at three or four points within the restricted business district. They may be carried for several miles before any unloading takes place, and then are dropped off in small groups as on an ordinary suburban line. The exact reverse of this process takes place with inbound cars, and in consequence the use of both center doors for an entrance or for an exit is of distinct value in decreasing the time of stops.

The front-exit door is under the control of the motorman, and it provides a means for short-distance riders to get off the car at congested loading points without interference from incoming passengers. It also eliminates the necessity for the conductor to leave the center doors open and unguarded when he gets off to throw a switch or to signal to the motorman at steam railway grade crossings. A mirror is installed over the right-hand front window at each end of the car so that the motorman can see what the conductor is doing without having to turn around. The mirror also informs the motorman of passengers moving to the front of the car to make use of the front-exit door, and is set at the maximum possible height so that there is no danger of the motorman's view being obscured by the heads of standing passengers.

When the car is in operation the conductor stands beside a stanchion placed in the exact center of the car, and entering passengers pass on either side of him in case both center doors are used for entrances. On this stanchion are two handles for operating the doors so that the conductor has no need to move out of his position. The fare box is carried in a frame of gas pipe hung from the center stanchion. It may be swung around on its support to either side of the car, and when the car is in operation it is located immediately in front of the open doors, thus providing a clear space in front of the passengers who make use of the folding seats along the doors on the blind side of the car.

There are only two handles for operating the doors, and they are carried on the center stanchion. Each of these handles operates one of the two doors on the entrance side of the car. When the car changes ends and the doors on the opposite side of the car are to be used, the operating rods which extend over the center stanchion to the operating mechanism of the door are disconnected, swung around to the other side of the car, and connected to the operating mechanism of the opposite doors. The connections are made by easily removable pins, and in order to avoid any possibility of connecting the doors wrongly, one of the two operating mechanisms on each side and one of the rods are painted red, and the others are painted black.

The destination signs are located in the monitor over the center doors, and at each end of the car is a large, illuminated route-indication sign in a wooden frame.

The seating arrangement of the car is a combination of cross and longitudinal seats. The ends of the car are provided with circular seats, no bulkheads being installed. There is also provided a single seat attached to stanchions at each end of the car. The stanchions are used primarily to support a folding seat for the motorman and to act as guides for a curtain at the motorman's back to keep the lighted interior of the car from obscuring his view at night. Folding seats are located in front of the unused doors on the blind side of the car.

There is a ramp in the floor between the trucks and the center. This gives a rise of 3 inches and, together with a transverse ramp between the step and the longitudinal center line of the car amounting to $\frac{11}{16}$ inch, makes the minimum floor height $24\frac{3}{4}$ inches. This is divided into one $15\frac{1}{4}$-inch step from the ground and one $9\frac{1}{2}$-inch interior step. At the front exit the floor height of approximately 2 feet 5 inches is divided into three steps, of which two are interior, of about $8\frac{1}{2}$ inches each.

A notable innovation is the use of immovable semicircular seats at both ends of the car. The controller at each end is set below the seat and the shaft is extended up through the seat and through a pipe railing slightly above the ordinary height of an arm rest. When the car is being operated in either direction, the controller and reverser handles are put in place on the shaft of the controller drum, the motorman standing back of the fixed seat at the front end. The controller-drum handle extends through the hollow reverser shaft so that both handles have the same center. Through the pipe railing also extends the shaft of a mechanically operated sander, and at the right of the motorman another piece of pipe railing affords a support for the removable hand-brake wheel and air-brake handle. At the rear end of the car all of these handles are removed, leaving the pipe railings with no projecting pieces and permitting passengers to use all of the end seats.

All doors are of the interior combined swinging and sliding type standard on the Pittsburgh Railways, and are mechanically operated by short handles on interior stanchions. The approximate net door opening is 2 feet 4 inches. While the extreme car width is 8 feet 2 inches, the ends are reduced to 7 feet. The cars, complete with double-end control and couplers at each end, weigh 38,000 pounds.

Cars on Long Island.—No section of a city previously neglected or undeveloped has grown with more astonishing rapidity than the portion of Long Island eastward of Brooklyn and reached by the newer bridges, particularly the Queens Borough, passing high over Blackwell's Island. The demand for transportation has been intense, and is being met in some instances by the newest types of center-entrance, stepless cars. The Manhattan & Queens Traction Corporation, which operates between Fifty-ninth Street, New York, and Jamaica via Queens Borough Bridge, Long Island City, Elmhurst, and Forest Hills, has 25 center-entrance cars. The general design is very similar to that devised and used by the Brooklyn Rapid Transit System. The seating capacity is 52, and the weight, fully equipped, 20 tons. The builder could have made the car a little lighter, but certain restrictions in connection with operation over the bridge made it desirable to have a construction with more than the usual factor of safety. The general dimensions of the cars are as follows:

Length over vestibule ends, 45 feet.
Length over buffers, 45 feet 6 inches.
Truck centers, 22 feet.
Height from rail to top of roof, 11 feet.
Length of center-entrance platform between two compartment bulkheads, 7 feet 1 inch.
Width over side sheathing, 8 feet 4 inches.
Width over eaves, 8 feet 4 inches.
Width over belt rail, 8 feet 5 inches.
Width over window sill, 8 feet 5⅝ inches.
Width of aisle, 26 inches.
Length of seat, 36 inches.
Wheel base of truck, 4 feet 6 inches.

The bottom framing is of steel with a 6-inch 8-pound channel for the bottom member of the side girder. The side girder is of 29½-inch by ⅛-inch plate with a 3-inch by ½-inch bar for the top member. The 6-inch channel is made in one piece which is bent down at the center for the platform or well. The sills are 4-inch, 7½-pound **I**-beams spaced approximately on 3-foot centers. The vestibule-end frame and the center-entrance platform are reinforced with diagonal braces. The end sill is built up of steel plates and rolled shapes. The vestibule ends are sheathed with sheet steel and have buffer shields. Cast-steel bolsters are used.

All posts of the body framing are made of 1½-inch by 2-inch by ¼-inch T's bent around from side sill to side sill and forming carlines, and all have post-ash strips to serve for sash guides. The upper sash is stationary, while the lower sash is arranged so that it can be raised. The center-entrance posts are of T's and pressed channels with a plate and channel over the door to provide compression members in the side-girder construction. The vestibule ends have wooden posts with outside bar reinforcements.

The roof is of plain-arch type. The T-posts which form the carlines have ash roof nailing strips bolted on the top and sides for the attachment of the ceiling. The roof boards are ⅜-inch tongued and grooved poplar. The vestibule-end roof is supported on ash carlines bent to shape. Below the sash rests the cars are finished in ⅜-inch mahogany sheathing, which is applied between the posts with an allowance for ½-inch air space between the outside girder plate and this wainscoting. All the metal trim is of highly polished bronze.

The flooring in both ends of the car is sloped downward for 3 inches from the bolster to the center entrance, while the floor of the center well is sloped 1 inch downward toward the door.

The pair of center doors on each side are of the sliding type with glass panels; they operate simultaneously with the steps. Hinged doors for the use of the motorman only are provided in the vestibules.

Cars in Brooklyn, N. Y.—The center-entrance trolley car developed by the Brooklyn Rapid Transit Co. is a double-end, straight-bodied type, with low-step passenger entrance and with two exits located at the center of the car and arranged for the collection of fare as the passenger enters. The car floor at that point is 14 inches above the rails at the threshold, with 2 inches of ramp to the center. Inside the car is a 10-inch riser from the central platform subfloor or well to the center aisle on each side. This aisle has a ramp of 6 inches in 8 feet 6 inches to the bolsters, from which points the floor is level.

The center entrance and exits are divided by stanchions and railings to give a clear entrance of 32 11/16 inches in the center and a 21⅜-inch exit on each side. The pivoted railing, which can be swung from one side of the car to the other, depending upon which set of doors is being operated, divides the incoming from the outgoing passengers. The lower panels of the side doors are of clear wired glass to permit unobstructed observation by the conductor while the doors are closed. Soft-rubber buffers are attached to the doors to avoid injury to passengers and damage to their clothing. A locked swing door 21½ inches wide and 5 feet 5 inches high is provided at each end of the car for the exclusive use of the motorman. This door is made of welded steel with one drop and one fixed sash.

The car seats 58 passengers, making the deadweight per passenger 671 pounds. The original seating plan called for 16 cross seats of reversible type with a 26-inch aisle between, longitudinal seats at the center doors, and curved seats at the ends. This general plan has been retained as giving maximum seating capacity without congestion at the center, but ingenious improvements have been made in seats which are in or out of service, according to the direction of running. In the first car of this type, the end seating was so arranged that the section directly behind the motorman was hinged upward at each end when the cab doors were swung out for service, and the outer ends of the seating near the cross seats were raised in like manner with the change in direction. The newer end seat is a semicircle seating eight passengers and made of four hinged segments, each quarter circle consisting of a long segment near the motorman and a short segment which opens outward to a supporting piece on the adjacent cross seat. Before the motorman makes up the cab by bringing out the two swinging sashes he turns over the end of each half circle of seating, thereby doubling its thickness and halving its length. The upwardly hinged seats were discarded to save time in changing from one end to the other. The curved end seats are finished on both sides, and to avoid the tearing of clothing they are made with screws which are inserted transversely through the slats.

In the first car the seats opposite the center door were arranged to slide horizontally under the adjacent longitudinal seats on the higher floor level. This has been superseded by a new arrangement in which each half of the seat is brought into place by swiveling it downward on a rod carried on the upper floor between the side of the car and an aisle stanchion. When not in use, each half is kept vertical by a double-acting lock which fits into a retaining bar. Both seat halves are alike except that one carries a folding leg which is automatically locked into place when the seat is up. The seat with the leg is dropped first. These seats and the pair of center doors not in service are interlocked both mechanically and electrically to prevent the improper opening of the door.

The cross seats are 34 inches wide. They have but one pedestal each, the other ends of the seats being carried by pressings between the posts. The arm rests are of mahogany. At each side on the upper level near the door is a longitudinal seat with space for three passengers.

The motorman's cab presents a departure from the original design in that the folding doors have been replaced by a lighter, cheaper, and faster combination, consisting of two swinging sashes, which are carried only to the height of the seat backs, and an intermediate curtain which is drawn down behind the motorman to screen him from the light of the car interior. The cab is prepared for service by folding the curved seat, next swinging out the two sashes to an angle of about 45°, and then inserting the separator or tiebar, which when not in use is kept hinged in an upright position on one of the swinging sashes. These sashes have curtain grooves, the curtains being placed in moldings in the bulkhead above so that when the sashes are opened in position to form the cab the grooves will be in the proper place to receive the curtain fixtures.

Each car is mounted on two "maximum-traction" trucks with 4-foot 6-inch wheel base, equipped with 28-inch driver wheels and 21-inch pony wheels. The driver axles are of heat-treated carbon steel, with $3\frac{1}{2}$-inch by $7\frac{11}{16}$-inch journals, and the pony axles of open-hearth hammered steel, with 3-inch by $7\frac{1}{2}$-inch journals.

The traction equipment consists of two motors rated at 40 horsepower at 500 volts and 50 horsepower at 600 volts. These motors are wound for field control. The gear ratio is 61:14. On tapped field they are capable of giving a maximum speed of 25 miles per hour and on full field a maximum speed of 21 miles per hour. The motors have a maximum vertical height of 2 feet 1 inch and a maximum width of 4 feet $\frac{7}{16}$ inch. Compared with older motors, these dimensions mean a saving of 2 inches' clearance below the axle.

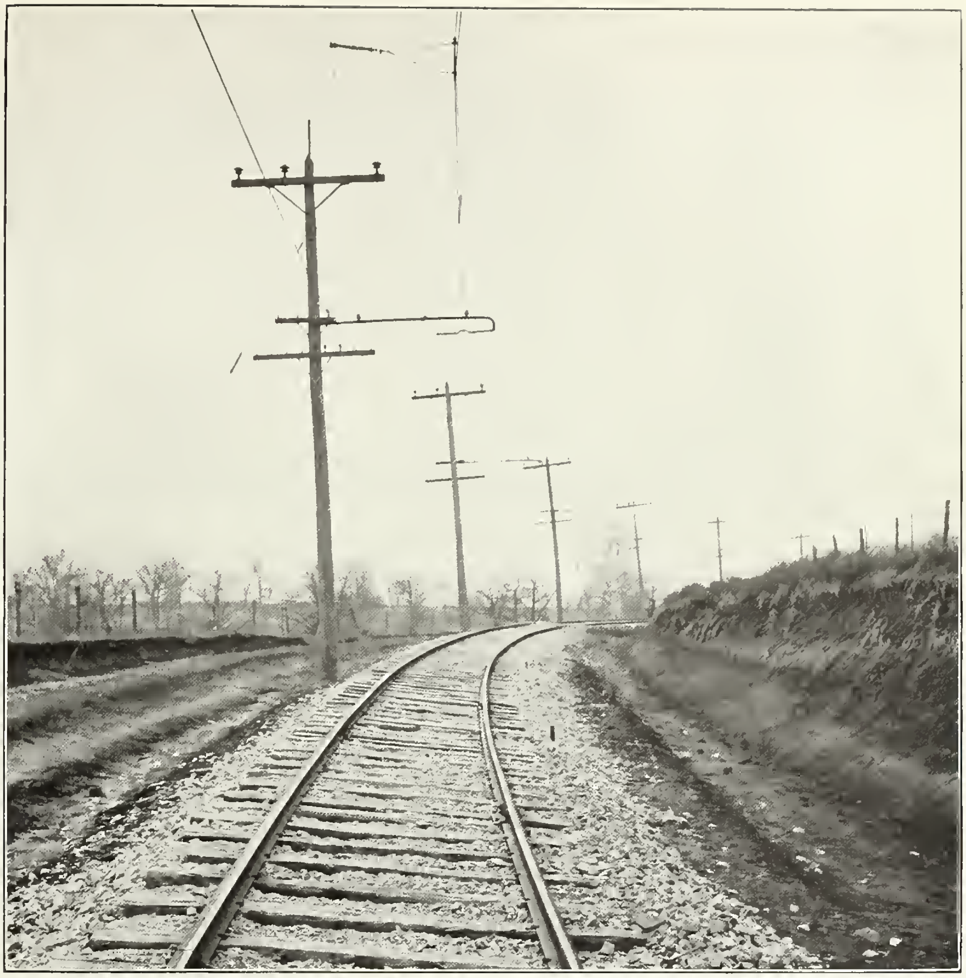
Fares and transfers are collected as the passengers enter. The entrance railings lead the passengers to the conductor, who is stationed at his pedestal in the center of the well. The pedestal is a revolving device with a change table on the top, where fare is paid by the passengers. The weight of the latest car, including drawbar fittings, etc., is 28,900 pounds, compared with 39,550 pounds for the first car.

NEW TYPES OF ELECTRIC SUBURBAN LINES.

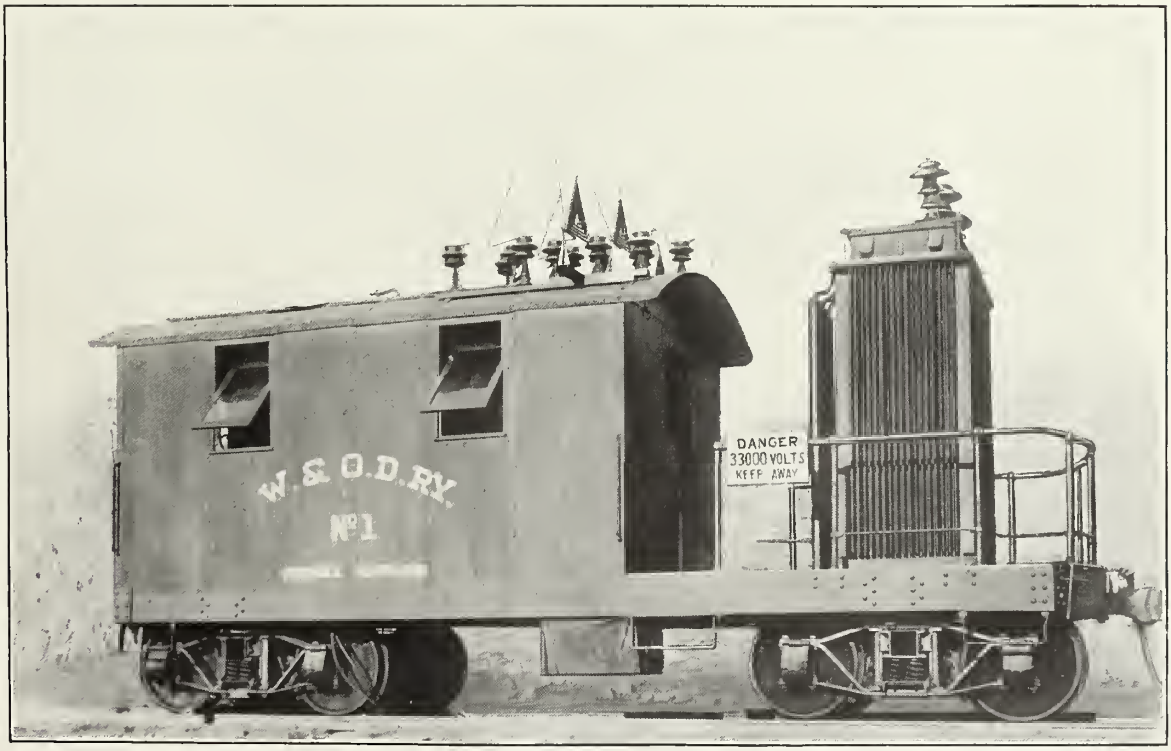
At the time the previous report on street railways was issued there was a marked tendency to use direct current for city and limited suburban traffic and to use alternating current for interurban lines. The direct-current voltage employed was then around 600 or 700 volts. In the interval, direct-current voltage has been carried up to 1,200 to 1,500 volts, and a number of new lines using this voltage have gone into operation. On the other hand, several new lines have been equipped by the earlier methods, such as the 40-mile suburban extension of the Waterloo (Iowa), Cedar Falls & Northern Railway, which uses 600 volts direct current. More interest attaches, however, to the new types operating at a direct-current voltage twice as high, with many incidental economies and advantages. A few examples may be cited.

Oakland, Antioch & Eastern Railway, Cal.—Interurban electric systems are fast supplanting the steam railway in the vicinity of San Francisco. Among these may be mentioned the Peninsula System between San Francisco and San Jose, and the Key Route extension between Oakland and San Jose, each 50 miles in length; the Ocean Shore Railroad from San Francisco to Santa Cruz, covering a distance of 65 miles, operated part way as a steam road; the Fresno & Monterey Railroad, which very materially shortens the distance from the center of the San Joaquin Valley to tidewater; the Northern Electric Co.'s line from Sacramento to Vallejo, which, with the Suisun and Vacaville extensions, is over 60 miles in length; and the Oakland, Antioch & Eastern Railway. This last company operates a regular train service between Oakland and Bay Point, Contra Costa County, a distance of 31 miles, and through trains between Oakland and Sacramento, 85 miles distant.

Starting from the main Oakland depot at Fortieth Street and Shafter Avenue, the Oakland, Antioch & Eastern line extends up Shafter Avenue and across the north arm of Lake Temescal. Thence it winds up Shepherd Canyon on a 3 per cent grade to the Redwood Peak Tunnel, which pierces the Coast Range for a distance of 3,458 feet. Most of the tunnel is through solid rock, and all that is not is lined with



CATENARY LINE CONSTRUCTION, KANSAS CITY, CLAY COUNTY & ST. JOSEPH RAILWAY CO.


W. & O. D. RY.
Nº1
DANGER
33000 VOLTS
KEEP AWAY

PORTABLE SUBSTATION; WASHINGTON, D. C. & OLD DOMINION RAILWAY.

(Face p. 380.)

reinforced concrete 24 inches in thickness on the sides and 18 inches in the arch. Located at the east portal is the largest of the five substations. From Bay Point across Suisun Bay to Chipps Island the Oakland, Antioch & Eastern Railway proposes to build a bridge 10,000 feet in length and 70 feet high over the navigable portion of the stream. The estimated cost of of this bridge is $1,500,000, and work has begun on it. While this bridge is being constructed, a ferryboat is used to transport trains across Suisun Bay. This boat is noteworthy, as it is one of the few gas-operated boats in the world used for car transportation.

Across Yolo Basin the road is carried on a trestle 13,900 feet long. In the center of this trestle a drawbridge has been erected over Montezuma Slough. There is a clear opening of 109 feet, and the draw is operated from land by remote control, a 1,200-volt, 15-horsepower motor supplying the power, which is transmitted by submarine cable. All of the roadbed between Chipps Island in Suisun Bay and Sacramento has been completed. It is heavily ballasted and oiled to prevent dust. The rails are ferrotitanium alloy, 70 pounds per yard, A. S. C. E. standard. The Oakland, Antioch & Eastern enters Sacramento by the M Street Bridge, owned partly by that company, partly by the Northern Electric Railway, and partly by the counties of Sacramento and Yolo. Between towns a speed of 60 miles per hour is maintained.

Current is supplied by the Great Western Power Co., whose main power house is on the Feather River, 18 miles north of Oroville. Five substations are required for the service of the Oakland, Antioch & Eastern Railway. They are 17 miles apart and are located at the east portal of Redwood Peak Tunnel, at Concord, at Montezuma, at Main Prairie, and at Glide's Levee, respectively. The standard substation equipment consists of one 750-kilowatt motor-generator and switchboard. These comprise one 1,300-volt, interpole, direct-current generator rated at 514 revolutions per minute; one 1,080-horsepower, synchronous, 11,000-volt, 3-phase, 60-cycle motor, with one 18-kilowatt, 125-volt, direct-current exciter on the shaft; one switchboard equipped with synchronous-motor panel; one direct-current general panel; and three direct-current feeder panels. The substation at Redwood Peak, which provides for the heaviest load, is equipped with two complete sets of this equipment, while each of the other four substations has but a single set. There is also one portable substation of 350-kilowatt capacity.

The overhead catenary construction is 1,200-volt No. 000 trolley, $\frac{7}{16}$-inch steel messenger, with a 600,000-circular-mil aluminum feeder. Pending the completion of the bridge across Suisun Bay, current is being transmitted from Bay Point beneath the surface by two submarine cables.

The company operates fourteen standard cars and two parlor cars. The former are 56 feet in length over all, 10 feet wide, and are divided into express, mixed passenger, and smoking compartments. There is seating capacity for 50 persons. The cars are provided with electric fans for summer and electric heaters for winter. Electric lights overhang all seats. The parlor cars, attached to the express trains, will seat 60 passengers and are provided with well-appointed buffets. Each car is equipped with four 140-horsepower, 1,200-volt, direct-current, interpole railway motors, control, and two dynamotor compressors. The trucks are of standard "trunk-line" type.

The heavy freight traffic is handled by two 50-ton electric locomotives, each equipped with four 160-horsepower, 600/1,200-volt direct-current interpole motors, electrical control, and two dynamotor compressors.

Nashville-Gallatin (Tenn.) 1,200-volt line.—A 1,200-volt direct-current interurban line has been completed and put in operation between Nashville and Gallatin, Tenn. It traverses a densely populated district northeast of Nashville and bordering the Cumberland River Valley for a distance of 27 miles. Except in a few places, the entire line is built on a private right of way, paralleling the old Gallatin turnpike, which passes through what is known as the "Blue Grass" district of Tennessee. Throughout the entire length the territory is urban in character, with a population averaging 800 people to each square mile on each side of the road.

This new line of the Nashville-Gallatin Interurban Railway sprang immediately into prominence as an interurban road because of the fact that it is the longest in the state of Tennessee. It is built with 70-pound rails laid on standard-size white oak ties spaced seventeen to 33 feet. The ruling grade is 3 per cent, and the maximum curvature 6 degrees, except on that portion of the city lines of the Nashville Railway & Light Co. by which access to the business district of Nashville is obtained.

The private right of way averages approximately 50 feet in width, except in places where this was not sufficient for heavy cuts and fills. To fix the alignment of all curves which are spiraled, 4-inch by 4-inch oak-post monuments are set in concrete at all points of spiral, at points of compound curves, and at points of tangency. These permanent monuments are set 7½ feet from the center of the track and painted with black letters on a white background. They show the degree of curve and elevation of the outer rail, and the monuments at points of spiral and at points of compound curve give the length of each. Practically all the heavy excavation is in solid rock, which made grading exceedingly expensive. Standard roadway sections include a 12-foot roadbed with 1½ to 1 slopes on embankments and a 14-foot roadbed in excavation. The standard slope in all rock cuts is ¼ to 1.

The overhead trolley and transmission lines are carried on a single line of 35 feet, 7½-inch-top chestnut poles set at 100-foot intervals with the face 8 feet from the center of the track. Two of the three No. 4 conductors constituting 33,000-volt, alternating-current, 3-phase transmission line are carried on a 5-foot two-pin cross arm near the top of the pole, with the third-phase conductor on a pole-top insulator. This arrangement permits a 52-inch spacing between the three conductors. This transmission line extends from the generating station of the Nashville Railway & Light Co. at Nashville to the substation at Hendersonville.

Pipe mast arms are attached to the pole below the transmission line so as to give 18 feet clear head room between the top of rail and trolley. Just below the mast arm a standard cross arm is applied which varies in length according to the number of signal wires. This cross arm also carries the feeder on the insulator nearest the trolley. The telephone circuits are on bracket insulator pins below this cross arm. Both the trolley and feeder wire are of No. 0000 round copper, and the latter is strain-guyed every quarter of a mile and at approaches to all important curves.

The initial rolling stock for this 27-mile road included four interurban passenger cars and one baggage car. The passenger cars are 50 feet 6 inches long over all by 8 feet 5¾ inches wide. The bodies are of arched-roof design, for single-end operation, with under frames of composite construction which are under- and over-trussed.

The car body is divided into a passenger and a smoking compartment, and the latter also serves as seating space for colored passengers. The motorman's cab is of good size, being 6 feet 3 inches over all, to provide space for light baggage. A two-leaf folding door on the right side of the cab permits the colored passengers to enter the compartment reserved for them without passing through the car. A 42-inch sliding door on the opposite side of this vestibule serves for loading and unloading the baggage. The rear platform is equipped with a single 36-inch two-leaf folding door and a triple-tread coach step on the right side. The total seating capacity is 54, with seats for 16 passengers in the smoking and colored-passenger compartment, and 36 in the main compartment. The interior finish, including linings, moldings, doors, and sash, is of cherry, mahogany finished, and the seats are upholstered in rattan, with brass fittings.

Four 600-volt motors are included in the car equipment. Two motors are connected in series for 1,200-volt operation, and are capable of 50 miles per hour. A change-over switch in the motorman's cab permits the motors to be operated in multiple when the car passes from the 1,200-volt interurban line to the 600-volt street railway line in the city of Nashville. The express and baggage car is arranged for double-end operation, and like the passenger car is built with a composite underframe and an arched roof.

The most novel feature in the auxiliary equipment of this express car is an installation of two small power cranes to facilitate the handling of heavy freight. The underframing of the car body was reinforced to carry the additional strains imposed by the operation of these cranes. The hoist standard is composed of two sections of channel iron fitted into castings on the car floor, and just above the 7-foot sliding doors. These castings form a pivot for the vertical member, which in turn supports a horizontal boom. Inside of the channels of each crane a 3-inch air cylinder with a 24-inch piston stroke has been installed with the cylinder at the bottom, which permits the piston to travel upward.

A sheave wheel is mounted just above this air cylinder and on a level with the horizontal member of the crane. This wheel and a second sheave wheel set in the end of the piston rod are employed in raising and lowering loads to and from the car. The horizontal boom is built of two plates placed so that a pulley may be set between them, five pairs of bearing notches being provided for this purpose. The location of the pulley on the boom depends on the weight of the load and its distance from the car door. With a normal air pressure on the car, the hoist is capable of lifting 800 pounds. Each hoist is pivoted beside the sliding doors so that it may be swung out through the door opening. A hose-and-pipe connection to the air-brake reservoirs supplies air to the hoist cylinder, which is operated by a straight-air valve attached to the side of the upright member of the hoist.

Pittsburg-Butler high-voltage railway.—The Pittsburgh & Butler Street Railway was the fifth single-phase interurban road in the United States to substitute 1,200-volt direct current for the single-phase alternating system. The road affords an unusually good opportunity for a comparison of the relative merits of the two methods of propulsion, as it had five and one-half years of single-phase operation. With the 1,200-volt direct-current apparatus the same car bodies are used, and the new motors are of the same nominal rating as the former ones. Under these conditions a reduction in power consumption per car-mile of not less than 15 per cent has been shown by a comparison of power-house records for the months of August, 1913, and August, 1912. In addition, the mechanical and electrical force at the car house was reduced 54 per cent, exclusive of car washers, etc.

The total length of road operating in 1913 on 1,200 volts was about 28 miles. For a distance of 6 miles, from Etna to the Pittsburgh terminal, the cars operate on the 600-volt trolley over the tracks of the Pittsburgh Railways. At the Butler end of the line the substation of the Butler Passenger Railway, an affiliated company, is utilized to supply current to 4¾ miles of track.

The track gauge is 5 feet 2½ inches, conforming to that of the Pittsburgh Railways. The road for the greater part of the way passes through a hilly country, making operation especially severe on account of the extra power requirements and the unusually heavy duty on the equipment. There are three grades averaging from 7 per cent to 9 per cent, while frequent lesser grades range from 3 per cent to 5½ per cent. A grade of 9 per cent is encountered near Etna, and at a point about 5 miles north of the Gibson substation, near Bryant, the south-bound cars ascend a 6 per cent grade with an 8-degree curve. The road from Etna to Butler is single track throughout, and with the exception of short stretches through the larger towns, is over a private right of way.

Electric energy generated at the power house at Renfrew, 5¼ miles from the Butler terminal, is transmitted to two rotary converter substations at 22,000 volts, and there is transformed to direct current at 1,200 volts. The power house at Renfrew, which was originally used to supply single-phase current to the trolley through transformer substations, has been adapted to supply 3-phase current to the rotary substations. This power house contains one 1,500-kilovolt-ampere and two 750-kilovolt-ampere horizontal steam turbine units connected to deliver 3-phase, 25-cycle, 6,600-volt current. By a rearrangement of the single-phase transformers, this current is now stepped up to 22,000 volts, 3-phase, for transmission. Besides the supply to the 1,200-volt substations at Mars and Gibson, alternating current is transmitted to the 600-volt substation of the Butler Passenger Railway at Butler. The same 3-phase lines provide power for the lighting circuits in that city and in towns along the line.

There are two substations containing identical equipment, one at Mars, adjoining the car house, and one at Gibson, near the city of Etna. A transmission line of three No. 4 copper wires extends the entire length of the system, the original single-phase line having been utilized by the addition of a third wire. The 1,200-volt circuit also was reinforced by additional feeders, and the rail bonding was, of course, renewed throughout.

The substation and car house at Mars are approximately 17 miles from Etna and 16 miles from Butler. The distance to the Renfrew power house is about 10 miles. The two equipments in each substation are in exact duplicate, each consisting of a 300-kilovolt-ampere, 25-cycle, 1,200-volt synchronous converter, a 300-kilovolt-ampere, 3-phase, oil-cooled transformer, and the necessary switchboard with feeder and starting panels. The incoming 22,000-volt circuits are protected by a four-tank aluminum lighting arrester. These lines are also provided with choke coils and disconnecting switches. On the high-voltage side of each transformer are three single-pole, 22,000-volt, 300-ampere automatic oil switches, installed in brick cells and hand operated by means of switch levers mounted on a slate panel.

The transformers are Y-connected, with 740-volt secondaries. Four 2½ per cent taps are provided in the primary side, thus allowing adjustment between 19,800 volts and 22,000 volts. A one-half-voltage tap is provided on the secondary side for starting purposes. These transformers are of the standard railway type with high inherent reactance.

The synchronous converters are rated at 300 kilowatts, 750 revolutions per minute, 1,200 volts, and are provided with the usual end-play, speed-limit, and brush-raising devices. These machines are capable of 50 per cent overload for two hours and three times normal load momentarily. A separate switch panel is used for starting from the alternating-current side. The direct-current switchboard consists of four standard 1,200-volt panels, including a synchronous converter panel for each machine and two feeder panels. A standard 1,200-volt, direct-current aluminum lightning arrester is provided for each of the outgoing feeders. One machine is sufficient to handle the entire load except for a few hours in the morning when the first cars are leaving the car house. The proper taps are used on the primary side of the transformer to give 1,300 volts on the direct-current side of the rotary converter.

The Gibson substation is 1 mile from the end of the line at Etna, and contains exactly the same equipment as the Mars substation.

As mentioned before, at the Butler end of the road for a distance of 4¾ miles the trolley is fed from the 600-volt substation of the Butler Passenger Railway Co. The present equipment of the substation includes two 500-kilowatt synchronous converters, which have ample capacity to take care of the maximum load requirements of both systems.

Eleven of the 13 original single-phase car equipments have been replaced by 1,200-volt, direct-current apparatus. These cars include 10 combination passenger and baggage cars and 1 express car. The passenger cars have passenger and smoking compartments, and all but 2 are provided with baggage compartments for light freight and package express. The total seating capacity is 52 passengers, and the estimated weight of the car with average seated load is 37 tons. This is a reduction of 6 tons from the weight of the same car equipped for single-phase operation. This reduction was made possible by the elimination of the transformer and duplicate alternating-current, direct-current control, and a reduction of 1,500 pounds in the weight of each motor.

The principal dimensions and weights of these cars are shown in the following statement:

Length over all, 51 feet 3 inches.
Width over all, 8 feet 1½ inches.
Height from track to roof, 13 feet 6 inches.
Distance between truck centers, 27 feet 6 inches.
Wheel base of truck, 6 feet 8 inches.
Weight of car body, 30,000 pounds.
Weight of trucks, 17,000 pounds.
Weight of electrical equipment, 22,000 pounds.
Weight of brakes and compressors, 1,800 pounds.
Average passenger load, 4,000 pounds.
Total weight, 74,800 pounds.

The electrical equipments of these cars are identical, with the exception of the gear reduction on the express car motors. The four motors used on each car are of the internally ventilated, commutating-pole type, rated at 100 horsepower on 600 volts.

The installation of the apparatus on the cars is an unusually good example of car equipment, and several features deserve special mention. All wiring is in conduit, and every conduit is a straight pipe, which simplifies the pulling in of wires and cables. Special cast-iron outlet boxes are suspended directly over the resistance grids, and the grids themselves are carefully insulated to prevent damage from snow. The motor leads are also well protected from injury by use of cast-iron terminal boxes on the car and special wooden terminal blocks on the motor case. Each lead is covered with rubber hose armored with brass wire, and the outlet box is placed near the center of the bolster to obtain maximum flexibility. Hangers and boxes, and in fact all accessories, are interchangeable on all cars.

Among the changes made in the cars to adapt them to direct-current operation is included that in the roof covering. With the single-phase equipment, a grounded copper sheathing was used on the car roof to ground a broken trolley wire. For direct-current operation the cars are covered with canvas, and the trolley deck running the entire length of the car is insulated for 1,200 volts.

The change from 6,600 volts single-phase to 1,200 volts direct-current was accomplished without interruption to traffic. After the first two cars had been equipped for 1,200 volts, the system was changed over from Butler to Mars, passengers being transferred to the single-phase cars at Mars. On August 1, 1913, direct current was thrown on the entire system, and four additional cars were put in service on the regular schedule. Since the inauguration of the 1,200-volt service no trouble of any kind has developed in the operation of the electrical equipment.

TRACK CONSTRUCTION.

Maintenance of track is one of the large and serious problems of the street railway industry. The subject has been covered fully in previous reports, but these necessarily dealt with conditions subject to constant change. Of these changes and developments no more striking or interesting illustration could be given than the history of the girder rail so largely in use in American cities for street railway service. At its meeting in Atlantic City in 1913, the American Electric Railway Engineering Association adopted four standard girder rails for tangent and curved tracks on paved streets. In commending this action, Mr. Martin Schreiber, engineer of maintenance of way of the Public Service Railway Co. of New Jersey, noted the fact that three years earlier no fewer than 200 different types of rail were found to be in use in the industry.

Data on girder-rail development.—While it was true that "live" sections were considerably less than this in number, still many of the sections in use then were available, and rolls and equipment were yet on hand for the manufacture of many of them. It is only fair to concede that electric railway engineers had fully realized that standard rails would eventually mean better service and cheaper track, but the situation had not been altogether in their control. Besides, the development in the electric railway industry, especially of equipment, was not mature, and the time has hardly been ripe for standard rails until now.

Mr. Schreiber traced the development of the standard girder rails that were finally proposed by the engineering association. The first actual design of the grooved girder rail for paved streets was that proposed as standard by the committee on rails and rail matters of the American Street and Interurban Railway Association, presented at the 1907 convention. There were two 9-inch and two 7-inch grooved rails, the former weighing 137 pounds and 122 pounds to the yard, respectively, and the latter weighing 122 pounds and 98 pounds to the yard, respectively. In the same report were also recommended two 7-inch and two 9-inch tram rails, together with designs for 7-inch and 9-inch guard rails for use with both grooved and tram sections. The committee on way matters for 1910 approved the principles outlined in the previous reports, but submitted in detail for consideration new designs for 7-inch and 9-inch grooved girder rails. The reasons for submitting alternative designs were that the committee considered the previous sections to be too heavy and their first cost too high.

In 1911 the same committee revised the work of all preceding committees and confined its attention to the design of a 9-inch grooved girder rail, submitting a thorough and careful analysis of the principles which governed each detail. The design submitted by this committee comprised one radical departure from any other rail section that had previously been in use or proposed, in that it provided for a tapered web. The reason given by the committee for the change in design was a mathematical one. It was explained that in the case of wagon loads on the tram, or when cars sway from side to side, the web acts as a cantilever and its stability is directly proportional to the cube of the cross section at the base. The 9-inch rail submitted by the committee, therefore, had about two and one-half times the stability of the rail with the straight web nine-sixteenths inch thick, although containing practically the same quantity of metal. The committee of 1911 was very anxious that the 9-inch girder rail proposed by it should be adopted as standard, but the convention decided that it would be better to prepare designs for both the 7-inch and 9-inch rails for straight track and the 7-inch and 9-inch rails for curved track, rather than a design for one rail only. Accordingly, the committee on way matters for 1912 approved the

9-inch design submitted by the 1911 committee and also presented three additional designs covering a 7-inch grooved rail for straight track and a 7-inch and a 9-inch guard rail for curved track. Although these four designs appeared to be very nearly what was required, the committee on standards did not approve the recommendations of the way committee, principally on account of the contour of the throat of the guard rail, and referred the whole question back for further action of the way committee reporting to the 1913 convention.

The 1913 committee on way, guided by the experience of all previous committees and the large number of discussions that had occurred, was determined to produce satisfactory designs. Accordingly, it submitted at the 1913 convention plans for four standard rails, including those for straight and for curved track, both 7-inch and 9-inch. Not only were these designs approved by the committee on standards, but the action was also ratified by the convention, and the rails are now the standard for the association. Thus, after six years of continuous work, there are four standard rails. It is interesting at this time to compare the original rails, as produced by the 1907 committee, with the rails recommended by the committee of 1913. If one compares only the weights of the rails, there is very little difference. Closer examination, however, develops the fact that a great deal has been accomplished. In the first place, in 1907, 16 rail sections were proposed as standard, in 1913 only 4. This is due to the fact that the 1913 committee felt justified in eliminating the tram rail altogether, and to the further fact that it proposed only one 7-inch and one 9-inch rail instead of two of each. At any location where a tram rail would be allowed by the municipal authorities, it seemed that a T-rail would be just as efficient from the latter's point of view, and certainly greatly to be preferred to any other type of rail from the railway company's standpoint. If the T-rail were not approved, it seems that there would be no reasonable alternative but the grooved girder rail.

One of the 9-inch grooved rails of 1907 weighed 137 pounds and the 9-inch grooved rail of 1913 weighed 134 pounds—a difference of only 3 pounds. There are, however, material differences in design. The contour of the head is modified, in that the width of the wearing surface of the later rail is 2⅛ inches as against 2¼ inches in the old rail. The depth of the bevel of the new design is $\frac{1}{16}$ inch greater than in the 1907 rail, and the length of the bevel is ⅛ inch greater. The advantages of these changes accrue principally to railways that are still using a narrow tread of wheel, in that they allow longer life of the rail before ridges appear on the wearing surfaces. The over-all width of the head of the 1913 rail is ⅜ inch greater than that of the 1907 rail, and the depth of the lip below the head is ⅛ inch less. These latter changes were made to afford better paving and vehicular conditions.

Another important improvement in the 1913 rail is the increase in depth of the groove from 1¼ inches to $1\frac{7}{16}$ inches. This point was very difficult to decide, on account of the early practice providing a depth of only 1⅛ inches, while some of the rail rolled during the last few years has a depth of 1½ inches. It is very desirable to have the groove deep to give maximum wearing value to the head; nevertheless, this has been thought undesirable by many, because of vehicular traffic and of the cutting down of the fishing depth, especially in the case of the 7-inch rail. The design of the web of the new rail is entirely different from that of the old in that the taper of the 9-inch rail is ½ inch at the top and ⅝ inch at the bottom. This arrangement increases the stability, tending to prevent corrugation, which has been a serious menace, particularly in the last few years. The width of the base of the heavy 1907 9-inch rail was 6½ inches, while that of the rail proposed by the 1913 committee is only 6 inches. In the committee's opinion, it was only necessary to design a base that would be of sufficient width for bearing, and at the same time the narrow base allowed more uniform rolling.

Generally the same arguments apply to grooved guard rails, but in the latter there is a distinct tendency toward a change of contour and an increase in the width of the throat. The design of the throat of the guard is altogether a question of construction of the equipment. The equipment has been considerably developed since the 1907 committee's deliberations were presented. In fact, it is now generally conceded that it is necessary to provide a guard that will take care of a standard A. E. R. E. A. flange and a wheel base varying from 4 to 6 feet, with radius of curved track varying from 40 feet upward. The fact that the throat in the guard rail had been designed only 1¼ inches deep seemed to be an advantage because the wear on the guard is not apt to come on the bottom of the groove but rather on the sides, and the decrease of the groove allows an increase in the depth of the guard, which is desirable on account of the large strain on the guard by the wheels of cars taking curves.

T-rail construction.—A very large amount of T-rail construction is in use throughout the country, and there is abundant evidence as to its persistence as a type. Its prevalence can best be shown, perhaps, by considering one part of the country. A description of conditions in Connecticut, by Mr. R. C. Cram, formerly of the Connecticut Co., furnishes the required data, while the report of the public utilities commission of Connecticut for the year ended June 30, 1912, is one of the very few state reports giving data as to type of rails and pavements used by street railways. An analysis of the report shows that the 10 operating companies in the state reported a total of 1,055 miles of single track. Five companies, operating about 150 miles, reported no girder rail whatever, thus confining the use of girder rail to the other five, four of which reported only 7 miles of girder rail about evenly divided between the tram and the groove girder types.

Of the total mileage in the state, approximately 93 per cent is laid with 40-pound/95-pound T-rail, 4½ per cent with 70-pound/96-pound tram girder, and 2½ per cent with 85-pound/125-pound groove girder. Substantially 91 per cent of the girder-rail mileage is confined to the lines of the Connecticut Co., with about 60 per cent of this confined, in turn, to the lines in Hartford. In that city practically all of the original tracks were laid with tram girder rail, and these must be replaced with groove girder, as occasion arises, in accordance with an agreement between the city and the company made several years prior to the time when the Connecticut Co. acquired control of the property.

With regard to pavement, an analysis of the report shows a total of 336 miles of single track paved with various types of pavement. Included in this total, however, are 26 miles of stone ballast (backfill above ties) which is not properly to be considered as pavement except for purposes of accounting. The net mileage of paved track is therefore found to be 310 miles, or approximately 29 per cent of the total mileage of tracks reported. The Connecticut Co. reported 288.1 miles paved, or substantially 93 per cent of the total paved mileage.

The following table shows the percentage which the mileage of each type of pavement used by the Connecticut Co. forms of the total paved mileage of that company:

CONNECTICUT CO.—PERCENTAGE DISTRIBUTION OF PAVED MILEAGE.

CLASS.	Per cent of total paved mileage of company.
Macadam	67.1
Brick	13.0
Cobble	5.6
Asphalt	5.4
Belgian and granite block	4.9
Wood block	1.8
Bituminous—Macadam and bitulithic	1.1
Granitoid	0.8
Hassam	0.3

If the mileage within the limits of the city of Hartford be excluded, it appears that about 90 per cent of the paved mileage in Connecticut is laid in conjunction with T-rail.

As to the T-rail and pavement situation on the lines of the Connecticut Co. in the largest five cities in the state, the two tables immediately following are significant:

CONNECTICUT CO.—PERCENTAGE OF MILEAGE PAVED AND PERCENTAGE OF T-RAIL IN LARGEST 5 CITIES.

CITY.	Population.	Mileage in city limits.	Per cent paved.	KIND OF RAIL—PER CENT.		
				T-rail.	Tram girder.	Groove girder.
New Haven	133,605	67.0	86.0	100.0		
Bridgeport	102,054	40.0	99.0	88.0	8.0	4.0
Hartford	98,915	50.0	96.0	10.0	50.0	40.0
Waterbury	73,141	34.0	79.0	88.0	8.0	4.0
New Britain	43,916	13.0	81.0	100.0		

CONNECTICUT CO.—PERCENTAGE DISTRIBUTION, BY CLASSES, OF PAVED MILEAGE WITHIN CITY LIMITS OF LARGEST 5 CITIES.

CITY.	Macadam.	Brick.	Wood block.	Cobble.	Granite block.	Belgian block.	Asphalt.	Bitulithic.	Granitoid.
New Haven	52.0	13.0	4.0	10.0	0.5	7.0	1.5	5.0	7.0
Hartford	76.0		0.5				23.5		
Bridgeport	61.0	16.0	20.0		2.0		1.0		
Waterbury	6.0	21.0	1.0	52.0	11.0			9.0	
New Britain	76.0						1.0	23.0	

NOTE.—Belgian and granite block are not separated in state report. Bitulithic included under "Bituminous macadam."

In commenting on the first and third of these tables it is to be noted that macadam, in general, is the predominating pavement in the largest cities, as well as in the total paved mileage in the state. The exception noted for the city of Waterbury, where cobble is found to predominate, is accounted for mainly by the fact that much of the mileage in that city is laid on quite heavy grades, where macadam is exceptionally hard to maintain between the rails, and also because it has generally been the custom to pave the tracks there with cobble whether the roadways outside are paved or not.

The objects sought were to provide a minimum flangeway for the maximum wheel flange in use, to eliminate both groove rail and special groove or nose block, to provide a reasonably smooth crossing for team traffic at right angles to the tracks, and to provide facilities for wagon wheels to turn out from the tracks with comparative ease as well as with safety. It is believed that these objects have been and are being satisfactorily attained. This is particularly worthy of note because the commission is the sole authority on the type of track construction to be used in streets, and its approval must be had in all cases of track reconstruction. In this connection it should be stated that while the commission, in many instances, has approved the installation of T-rail, it recognizes the fact that at times there may be some locations where groove girder rail would be preferable, also that the width and grade of streets and the volume and character of traffic must be carefully considered in any decision as to which rail may be the more suitable under all conditions. In only one case so far, however, has the commission ordered a groove-rail construction, after full investigation.

Methods of paving.—As to pavement, the experience of the Connecticut Co. has probably been about as extensive as that of any of the other important systems. The railways in Connecticut have only a limited control over the type of pavement laid within the track area, since they are required by statute to lay the same type of pavement in their section of the street as that laid by the municipalities in the other part of the street. Nevertheless, they are not required to lay a pavement which is more expensive, nor are they absolutely held to the same type provided they lay a pavement which is considered equally good as compared with that laid outside the railway area. As a rule, however, the practice is to lay the same type, the work being done by the same contractor under a separate contract with the railway company. There have been a few exceptions to this rule, where the contractor's bid for the railway work was in excess of the bid for the rest of the roadway.

The predominance of macadam may be accounted for, in general, by its low first cost, the abundance of trap rock, and the fact that until the advent of the automobile a good water-bound macadam roadway was sufficient to withstand all but the most concentrated traffic in the immediate centers of the cities and towns. Moreover, it can be well laid even with a 5-inch, 80-pound T-rail, is maintained at moderate cost, and is somewhat more adaptable for use with the T-rail than with the girder rail. It is thought that the tendency toward oiled macadam and the more recent forms of bituminous macadam will result in the continued use of such macadam pavement in connection with tracks where traffic is moderate and where the width of streets does not cause excessive wagon tracking at the gauge lines.

According to the tables, brick pavement is next in extent. The older types consisted mainly of the small vitrified shale pavers, while the more recent ones are constructed with the present standard paving brick or block. They have been laid almost universally with cement-grouted joints on a sand cushion and a 6-inch concrete base. The quite general adoption of brick in the past as a pavement may have been due to the fact that until the introduction of the modern types of grouted granite and wood-block pavements it was the only alternative to asphalt in the so-called "permanent pavement" class, and asphalt has never found much favor in Connecticut cities.

As a track pavement, brick has proved quite satisfactory up to the point where traffic following the rails becomes excessive. It can be well laid in connection with T-rail, and is quite readily replaced after street openings and track repairs, though at considerable loss of material. The use of any form of special "nose" or groove blocks, however, has proved very unsatisfactory. Moreover, it should be stated here that these installations of groove blocks were made only under vigorous protest on the part of the company.

While cobble appears as next in importance in the first table, it will suffice to say that its use is generally confined to tracks in outlying districts, often on grades, in streets as yet otherwise unpaved. As a material for this purpose cobble is very good, providing firm foothold for horses, and preventing the rutting between the rails which usually occurs, after a time, where tracks are merely back-filled with earth or gravel.

Asphalt occupies a rather anomalous position in the list, since it is confined practically to one city. What little remains in tracks elsewhere will no doubt be displaced within a year or two. There is every reason to believe that much of the disfavor in which asphalt is held as a pavement for railway streets in Connecticut is the result of its installation in connection with tracks which were too old and were in no way as substantial as the modern construction. Later installations would indicate that asphalt can be laid and fairly well maintained, under moderate traffic, in connection with a heavy groove girder rail. It is thought, however, that the well-known troubles incidental to asphalt maintenance are sufficiently grave to make its installation undesirable and something to be avoided as far as possible.

Belgian block occupies about the same position as cobble in so far as its value for use as a pavement is concerned, and it is rapidly disappearing.

Granite block as a track pavement has until recently been in little use in Connecticut. Such as there was consisted of the old type of 8-inch-deep blocks, laid on sand, mainly with sand joints. Within the past two or three years the value of the modern type of comparatively smooth granite pavement began to be appreciated, and several installations have been made. The construction is composed of a moderately soft New Hampshire granite, with blocks about 5 inches deep, 4 inches wide, and 8 inches to 10 inches long, laid with 1:1 cement-grouted joints on a 1½-inch sand cushion and a 6-inch concrete base. This construction has been adopted usually where grades and very heavy traffic are found, with 7-inch 95-pound T-rail.

In connection with grouted granite-block pavement a new method of construction is coming into use. The procedure consists simply in splitting old 8-inch to 12-inch granite blocks into from two to three parts, each about 4 inches deep, and laying them with the new split faces upward, all other parts of the construction being the same as with new granite. The cost of this method is, of course, much less than with new block, and the resulting pavement seems to be practically as good.

Wood block has been steadily coming into favor in Connecticut. The relative importance of this kind of paving is not properly shown in the first table, because several extensive installations were in progress at the date of the report on which the table is based. As a paving material it rivals granite, even when wear is considered, and is more readily cut in around obstructions. While trouble is had at times from the tendency of the blocks to buckle under certain conditions, such defects are usually quite easy to remedy. The result is a smooth, clean, quiet pavement, which is highly desirable, especially in residential sections. It is adaptable to both T and groove rail, and may be quickly replaced after track repairs, even in the winter time, with the least loss of material. It has been customary to lay this pavement on a 6-inch concrete base with 1-inch sand cushion and sand joints.

The experience with bituminous macadam is not of sufficient length to enable a more definite opinion to be formed than that expressed in reference to ordinary macadam. With regard to "bitulithic," however, it has been found that it is quite satisfactory for streets carrying a moderate traffic. When laid in conjunction with T-rails it has been deemed advisable to place wood or granite block at either side of the rail heads. Several large installations have been made, the earliest two in 1906. Neither of these required any expensive attention from the contractor at the expiration of the five-year guarantee period. In fact, after seven years they appear to be good for an indefinite period. The most objectionable feature would seem to be the dependence upon the contractor for such repairs as may be necessary from time to time.

Granitoid is a pavement with a concrete surface, usually laid out in block form on top to prevent slip. Where installed in Connecticut no attempt was made to interpose any form of joint or shock absorber between the rail and the pavement. It presents a neat appearance, but the block formations soon disappear under traffic. It is thought that perhaps for light traffic it may answer quite well, especially when first cost and comparative ease of repair are considered; but for heavy traffic following the rails, especially T-rails, it may be unsuitable.

In any track construction in paved streets the pavement is perhaps the most important feature, in relation both to total cost of the track construction and to the use of the street by the public. Mr. Cram believes that much of the objection which has been raised to the T-rail construction should more properly have been brought against the type of pavement used in connection with that rail. This observation is the result of experience in connection with several agitations over the T-rail question in Connecticut cities, where it has been found that agitation ceased after a T-rail installation had been made in accordance with the Connecticut Co.'s standard cross sections to replace the old tram-girder and asphalt-pavement construction. In fact, the new T-rail construction has been praised highly by both the press and members of civic associations.

Track in various cities.—With the idea that descriptive details of types of track to be used and installed during 1913 would be of general service, an article was published early in that year giving some interesting data for several cities, which are here quoted.[1]

The city track of the Waterloo, Cedar Falls & Northern Railway Co. is built with 12 inches of 1 : 3 : 5 concrete under the rails and carried up over the base of the rail. This is done to make sure that the concrete is in contact with the base of the rail, for the reason that if it were poured only up to the base, the space under the rail would not be filled and there would always be moisture there. Mr. T. E. Rust, chief engineer for the company, estimates that the ties are the weakest part of the track and uses them only to keep the rails in gauge. They are spaced 3 feet center to center and set in the concrete, which, rather than the ties, is depended on to support the rails. Seventy-five-pound T-rails and twin bonds are used.

The joint construction is of especial interest. It is made with angle bars and with a piece of old rail 24 inches long, embedded in the concrete in inverted position and in intimate contact with the rail base. This plan was adopted because of the fact that the concrete under the rail joint gradually wears away, and if the wearing surface is made of steel instead of concrete the joint stays in its originally perfect condition much longer. It is very essential, however, that the piece of inverted rail shall be in intimate contact with the rail, and in order to obtain this perfect contact, the piece of old rail, before the pouring of the concrete, is held up against the track rail by means of two pieces of No. 8 iron wire looped around both sections and over a ½-inch steel rod laid on top of the running rail and provided with two large set screws. When the wires are fastened tightly around the whole joint, these set screws are turned down, bringing the section of old rail into perfect contact, and the concrete is then poured in.

The Virginia Railway & Power Co., Richmond, Va., is using 9-inch girder grooved rail with electrically welded joints, together with a crushed stone and concrete substructure. A 6-inch layer of crushed rock is laid below the ties and 3 inches above their base, and 6 inches of 1 : 3 : 6 concrete is poured on this, bringing the level of the concrete over the base of the rail. Tie-plates and screw pikes are used. The ties are dimensioned 6 inches by 8 inches by 8 feet, and spaced at 2-foot centers.

The Toledo Railways & Light Co. is using 6-inch, 100-pound, open-hearth T-rail on sawed white-oak ties, untreated, 5 by 8 inches, 7 feet long. The ties are on a 3-inch bed of stone ballast, ½ to 1¼ inches, under which is a 5-inch base of 1 : 4 : 6 concrete. The rail joints have four-hole angle bars with 1-inch bolts. The rails are 60 feet long, laid with staggered joints, and with 30 ties per rail. The stone ballast is applied flush with the top of the ties and rolled with a 10-ton steam roller. On top of this is placed a 1½-inch layer of concrete to keep the ballast and roadbed free from water from the street. Neither tie-plates, tie-rods, nor rail braces are used. On the inside of the rails a wood filler block is placed next to the web. Next to this is placed a wood nose block, or one which has a corner beveled off so as to provide a flangeway for car and vehicle wheels. The paving blocks are laid on a ¾-inch cushion of sand, and the joints are filled with sand instead of the customary pitch or tar filler. Track drains are put in the centers of both tracks at depression breaks in the grade of the street.

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[1] Electric Traction, May, 1913.

The web of the rail along the outside of the track is filled with rather dry mortar, against which the paving blocks are laid. The tracks are laid at 9-foot 2¼-inch centers, with the inside rails ½ inch higher than the outside rails to fit the contour of the street surface. Cross bonds are installed 200 feet apart. The 3-inch ballast well tamped under the ties is enough to surface the track thoroughly and to distribute the weight quite evenly to the concrete base.

The Twin City Rapid Transit Co., Minneapolis, Minn., is using 7-inch, 91-pound T-rail laid on creosoted ties which rest on a bed of gravel 2 inches thick over a sub-base of crushed rock or gravel. The space between the ties is filled in with 1:3:5 concrete up to the base of the rails. On the track laid in unpaved streets, the company uses 5-inch, 80-pound T-rail supported on pine ties with gravel ballast under the ties and dirt filling between them. Bonds No. 0000 of U shape with the terminals welded to adjacent rails are used, the welding being done by means of an acetylene torch. The joints on the unpaved track are 26-inch four-holes. On paved streets the company uses a 7-inch, 91-pound rail, and all joints are cast welded. The paving in and between tracks is cut granite, laid on Portland-cement concrete. The paving outside of the tracks is generally of the same kind as put down by the city. Where practicable, the company prefers to put a couple of courses of granite blocks as stretchers along the outside of the rail. There is some objection to these rows of granite outside of the rail, except in the case of asphalt paving.

In the standard track construction of the Cleveland Railway Co., 7-inch, 95-pound T-rail is used, supported on steel ties spaced at 4-foot centers, with a 1:2:6 concrete substructure. A concrete stringer is laid under each rail to a depth of 12 inches and with a width of 12 inches. Between the rails the concrete is laid to a depth of 1½ inches below the ties. The joints are built with a 1-inch by 4-inch steel plate, 30 inches long, riveted on each side of the rail with four 1$\frac{1}{16}$-inch rivets on each side of the joint. These are put in hot under a pressure of about 100 tons, supplied by a 100-foot air compressor, and are riveted by a riveting machine. The base of the rail is welded by the thermit process. Steel ties are placed under the joints. In purchasing the rails, Mr. C. H. Clark, engineer of way, specifies 0.75 to 0.90 per cent of carbon, 0.10 per cent of titanium, 0.20 to 0.30 per cent of silicon, and not more than 0.80 per cent of manganese. Specifications are also drawn up for the rivets. In order to make certain a joint which will conform to the rail, the composition of the joint is specified the same as that of the rail. The drilling of the rails is required to be such that a driving fit of the rivets will be secured. This type of joint possesses the advantages of both the welded and the continuous joints. After the track is surfaced, the ball of the rail is brought to a true surface at all joints by the use of grinders.

The International Railway Co., Buffalo, N.Y., is using 124-pound girder grooved rail, fastened with screw spikes to 90 per cent heart long-leaf yellow-pine ties, untreated, and spaced at 2-foot centers. The substructure is made of 8 inches of 1:3:5 concrete, and a 2-inch layer of 1¼-inch crushed stone is laid between the concrete bed and the bottom of the ties. On top of this a second bed of concrete 6⅜ inches thick is laid, which comes up to the base of the rail. A 4-inch farm tile is laid in a hemlock trough along the center of the "devil-strip" 8 inches below the lower concrete sub-base. The tile is covered with crushed stone, and a 3-inch by 3-inch weep-hole filled with crushed stone is left in the sub-base every 10 feet. Any water which may seep around the ties then runs through the crushed-stone layer under the ties and through the weep-hole into the draintile.

The Georgia Railway & Power Co., Atlanta, Ga., digs a trench 8 feet 2 inches wide and 20 inches deep, and the soft spongy places are filled with good material and rolled with a steam roller, if practicable. Broken-stone ballast 5 inches thick, double tamped, is laid to come 1½ inches above the bottom of the tie. Sap pine, creosoted ties are used, and 9-inch, 89-pound semi-grooved rail in 62-foot lengths is laid with the joints staggered. After the track is surfaced on the 5 inches of broken stone, cement grout in the proportion of 1 part cement to 1½ parts sand is poured into the ballast.

Another type of construction used in Atlanta calls for the same rails, bonds, and joints as above, but the rails are laid with the joints opposite. The roadbed is graded 7 feet 8 inches wide by 9 inches deep, and rolled with a steam roller. Longitudinal trenches are then dug under the location of each rail, 10 inches beneath the base of the rail, 10 inches wide at the bottom, and 22 inches wide at the top. Cross trenches for the ties are dug 5 feet apart, the bottoms coming at the same depth as those of the longitudinal trenches except at the joint ties, where they are 2 inches lower. The joints of the track are square. After the trenching is done, the ties are placed in the tie trenches, the rails laid and spiked, and the track lined and surfaced on blocks, thin oak wedges being used to bring it to the exact line and surface. Concrete is then poured in the track to bring it up to the proper elevation for the street pavement.

After investigating the results obtained by different street railway companies throughout the country, the Texarkana (Ark.) Gas & Electric Co. decided, in 1910–11, to use a concrete paving surface along its double-track line on Broad Street, the principal thoroughfare in Texarkana. Two years' service since the installation of this type of paving gives some idea of what wear may be expected. The paving shows no evidence of failure, and the depth of wear is negligible. To obtain these satisfactory results, Mr. W. L. Wood, jr., general manager, had a rigid set of specifications drafted for the work. During the progress of the construction, both as to track foundation and as to paving, it was closely inspected and every precaution taken to produce permanency. The track cross-section contains 6 inches of 2½-inch crushed limestone laid in a trench 19 inches deep. This was rolled with a heavy road roller, and then the track was laid. It comprises creosoted yellow-pine ties of standard size laid at 2-foot centers and 70-pound A. S. C. E. rail spiked in place, the whole resurfaced to the finished elevation. To detect the weak spots, it was customary each night, after a section of new track had been laid and opened to traffic, to couple a general utility motor car to a 100,000-pound gondola car loaded with stone ballast and to run them back and forth over the new track until all possible weak points had been found. The following day the spots in the foundation under these points were pick-tamped to surface and again submitted to the ballast-car test load before the concrete was placed.

After the skeleton track had been brought to a permanent surface and tested, an additional quantity of crushed stone was cast between the ends of the ties in double track to the height of the tops of the ties, to reduce the quantity of concrete in the finished pavement. Then the paving foundation was laid. This consisted of 1 : 3 : 5 concrete brought up to the tops of the ties. The paving surface was laid with concrete in the proportion of 1 : 2 : 4, where the aggregate consisted of 1-inch crushed stone. No wearing-surface mixture was provided, but the paving material was placed comparatively dry or of a consistency which would bring the moisture to the surface if it were tamped. After the paving surface had been accurately formed with a templet which gave a ¾-inch crown between the rails and a 1¼-inch flangeway, the surface was floated to complete the job.

Expansion and contraction were provided for by ½-inch joints spaced at 6-foot intervals. Ordinary weather boarding of a wedge section was used as the insert at the expansion joints, and after the initial set it was replaced with an asphaltum filler. To prevent breaking down the edges of the concrete paving, particularly by the cross traffic at street intersections, flat bar iron of ½-inch by 4-inch section was laid edgewise to form a curb. Under all track special work and at each joint the crushed-stone ballast foundation was poured solid with cement grout just before placing the paving foundation. A period of 10 days was allowed for the concrete to set before traffic was resumed. Natural drainage was furnished by a good sandy subsoil.

Electric arc welding of track.—On the United Railroads of San Francisco eight or nine electric-welding outfits of the portable type have been in use since the beginning of 1912, and have proved thoroughly satisfactory in every respect. Through their use the road has been able to reclaim and rehabilitate many thousands of dollars' worth of material in the repair shops, and also a very large amount of rail and special work in the streets. In the latter case, corrugations and cup-outs have been built up easily and satisfactorily, as well as plates in hardened-center special work where the points have become broken or worn.

For repairs to track and special work, the apparatus is especially economical. The road reports that, for a very nominal sum, material to the value of several thousands of dollars is reclaimed annually and its life prolonged for several years. It is impossible to estimate the exact saving on track work through the use of electric arc welding, for the reason that, while the value of a new piece of special work may be $1,500 or $2,000, the actual cost of replacing the worn-out piece will amount to considerably more when the cost of labor for installation and the amount involved in tearing out and replacing the pavement are considered. As an example, it is stated that at one of San Francisco's busiest corners complaint arose on account of the noise caused by cars running over a worn double-track section. This section cost about $1,400, and the cost of replacing it with new material would have amounted to $1,000, but through the use of the process the road was able to rehabilitate the crossing, thereby prolonging its life for possibly several years at a cost of between $75 and $100.

The feature of portability affords the greatest opportunity for saving. In many cases where welding is done at a forge or furnace by a blacksmith, by far the greatest part of the cost of the complete operation is that which is involved in dismantling the damaged piece, transporting it to and from the forge, and reassembling it after the repairs are finished. The ability to bring the welding flame to the work and to apply it from almost any direction or angle eliminates practically all of this expense, and through the localization of the welding heat it has now become possible to make "spot welds," to weld in narrow strips along crooked lines, or to operate upon material of a degree of thinness which would prohibit its being handled in a forge or on an anvil.

This accounts largely for the great variety of work done with the electric arc, an example of which is given in the list of material repaired by the electric arc on the United Railroads of San Francisco. They regularly make repairs to gear cases, motor cases, axles, truck frames, axle bearings, and brake-shoe heads, where the dowel pins have become oblong, armature shafts where the keyways and the tapered pinion seats have become worn, axle caps, brake levers, bolster castings, brake hangers, controller backs, step castings, and in fact all car material or parts which need repair. In the track department the road has used the electric arc for repairing switch tongues, frogs, and mates and for filling up cup-outs, corrugations, and low joints in both straight rail and special work.

On the Pacific Electric Railway Co., a machine similar to those used in San Francisco is reported to be kept busy and to have done exceedingly satisfactory work in building up cupped rails. It is stated to have prolonged the lives of crossings and special work from eight months to a year. It is used to a considerable extent for cutting rails and boring holes in manganese steel. The operating cost to make a weld in a rail is reported to be approximately $3, Mexican labor being used, as it has been found that the apparatus does not require any special skill after the operators have been advised how to handle it.

STREET-CAR ILLUMINATION.

A very marked improvement was seen in the illumination of street cars during the period 1907–1912. By reason of the universal use of electricity in car propulsion, the lighting has also become electrical in like degree, but it has had to pass through considerable change and evolution from carbon-filament, tantalum-filament, and graphitized-carbon lamps up to the modern tungsten.[1] It is stated that about the middle of 1913, bare or unfrosted tungsten metallic-filament lamps were already in use, with a few tantalum, on approximately 28 per cent of the cars in service, bare graphitized-filament lamps on 10 per cent, and bare carbon lamps on 60 per cent. At that time, about half a dozen installations had been made with large tungsten units and shades. Although the incandescent filament lamp has been used for the lighting of street railway cars practically ever since the electric motor cars superseded the horse or cable cars, it has not been until within the last six years that any attempts have been made to utilize the generated light to best advantage by means of scientifically manufactured shades or reflectors; and it was not until 1912 that the tungsten-filament lamp of an efficiency of 1.4 watts per horizontal candle or better was perfected to the extent of making it sufficiently rugged for street railway service. There are several reasons for this slow development. Lighting energy, being but a small fraction of the total energy used by motors, and being relatively cheap to generate, has not been considered as a field for economy. The shortness of the periods during which individual passengers use the lighting has not been conducive to progress. Furthermore, the rough usage to which lamps and shades are necessarily subjected, the low first cost of the carbon-filament lamps, and the uncertain relations between private street railway corporations and municipalities, all are reasons for delay in better car lighting.

One of the first street cars using individual reflectors on lamps was put in service in 1900 by the Oakwood Traction Co., operating in Dayton, Ohio, although previously there may have been a few desultory attempts to equip lamp clusters with reflecting glassware. This car was equipped with center-deck, four-light fixtures, and side-wall, single-light brackets, using square-shaped alba glass shades. Cars with this equipment are still in service.

Around 1911–12 a number of traction companies installed bare 23- and 36-watt tungsten-filament lamps in place of the carbon lamps. When the majority of these new lamps had shown a life of 1,000 to 1,300 hours, progress was rapid toward the standardization of the present series lamps, and the shade, holder, and switch devices as accessories.

The lighting of street cars was previously accomplished by using bare carbon, and in a few cars graphitized-filament, lamps. It required from a dozen to thirty of the so-called 16-candlepower, 64-watt, carbon lamps in the car body, and 8 to 10 similar lamps distributed on platforms and in the headlight and designating signs. Between bulkheads the lamps were placed about 18 inches apart in line along the center deck, or studded over the whole ceiling, or else grouped in clusters of four, five, or as many as eight lamps arranged radially from single fixtures on the center-deck ceiling. Such carbon lamps usually burned five in series on the nominal 550-volt power circuit, each being rated at 110 volts.

The high current consumption of the carbon lamps, together with their poor illuminating performance, led to the substitution of, first, the metallized-filament lamps, and second, the bare 23-watt tungsten lamps in the same sockets. The former lamps proved unsatisfactory on account of filament breakage from jarring, and by reason of other objections, while the small unshielded tungsten lamps were but a temporary makeshift, on account of excessive glare and because no attempt was made to utilize the maximum amount of generated light or to direct it downward.

The most modern car-lighting equipment consists of one circuit of five tungsten lamps of the 94-watt, 78-candlepower size, arranged in line along the car ceiling, or else an arrangement of two circuits of five each of the 56-watt, 46.7-candlepower tungsten lamps. Quite often, in the cars where the 94-watt lamps are used, these are placed four in the car body between bulkheads and one over the entrance vestibule, especially if the car is of the pay-as-you-enter type. In other types of cars, such as the interurbans, there may be three units in the passenger compartment, one in the baggage or smoking room, and one in the vestibule. An additional circuit of five 23-watt tungsten lamps is used for the large types of city cars, particularly if these cars have the one circuit of 94-watt lamps. The small lamps are arranged over the steps, in the headlight, and in the illuminated designation signs.

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[1] S. G. Hibben, Illuminating Engineering Society, Sept., 1913.

Sometimes, but not often, the fourth size of modern lamp, a 36-watt, 26.8-candlepower tungsten-filament, is used in the car body, but the cases where the 23-watt or the 36-watt lamps are being employed between bulkheads are largely those where no new wiring or accessories are being installed and where these small lamps are replacing the carbon lamps in the old sockets or receptacles.

The four tungsten-lamp sizes mentioned above are those thus far standardized for street railway service. Their characteristics are given in the following table:

Characteristics of Tungsten-Filament Street Railway Lamps.

Watts.	Horizontal candle-power.	Watts per candle-power.	Lumens.	Average hours life.	Bulb diameter.	Over-all length.
23	17.1	1.34	168	2,000	2⅜	5¼
36	26.8	1.34	263	2,000	2⅜	5¼
56	46.7	1.20	457	2,000	2⅝	5⅜
94	78.3	1.20	767	2,000	3 1/16	7⅛

Any of these lamps are procurable for a power-line voltage of 525 to 650, or with individual ratings of 105 to 130 volts. They are sturdy in construction, and are selected for the current which insures a uniformity of candlepower and life.

All lamps in the most modern street cars are being equipped with "downward reflecting" shades. Several forms of holders are available. These holders clamp the neck of the glass shade all around, with a firm grip that can not jar loose, and in such a way that there is no probability of breakage if a well-made shade is used.

Two main factors are the criteria of the satisfactory qualities of the lighting system—the cost and the illuminating performance. The latter consideration involves the measurable amount of foot-candle value, the quality of the light that is furnishing this foot-candle value, and its physiological effects. Anyone who has seen a car illuminated by the shaded lamps, and particularly if this car has both shade and bare lamps that can be alternately burned, will not question the fact that there is a remarkable difference in the qualities of the light from the two arrangements. The glare from the bare-light sources is particularly disagreeable in street cars, and all-frosted bulbs can not do much to correct the fault. The car ceilings are low, and there is a vista along which the eye gazes. There are usually advertising cards to attract the attention toward the upper parts of the car, and there are unavoidable changes of intensity from car jarring and from voltage fluctuations that soon tire the muscles of the eye. Hence street railway lamps are being equipped with shades that protect the eyes of the passengers.

Every street railway must operate its lighting circuits and its power circuits as one. Hence at the very time when the lights are most needed the load on the system is the greatest, and the fluctuations of voltage are increased correspondingly. This trouble from voltage fluctuations was very apparent with the use of carbon-filament lamps, but it has become much less troublesome with tungsten lamps, since their candlepower does not change so rapidly at the different pressures.

At the meeting of the Chicago section of the Illuminating Engineering Society, November 12, 1913, Messrs. L. C. Porter and V. L. Staley presented a paper on "The Illuminating of Street Railway Cars." For car lighting, compared with carbon lamps, it was demonstrated that tungsten units produce better illumination at a saving in lighting expense. Where tungsten lamps are used it is desirable to install efficient reflecting devices, and in all cases a light interior car finishing is to be desired. The tungsten lamp for car lighting has reached a life of 2,000 hours in laboratory tests, and from 1,200 to 1,500 hours under service conditions. The strength of the lamp is such that it withstands surprisingly, bad operating conditions. It has practically superseded the tantalum lamp for car illumination.

The results of a study of car lighting made by Mr. G. H. Stickney, with the cooperation of Mr. E. W. Holst, of the Bay State Street Railway Co., were given. Two methods of placing the lighting units were tried, one being the use of a single row of fixtures down the center line of the car and known as center-deck lighting, while the other provides a double row of lighting units, one under each half-deck. There is little to choose between these two methods in efficiency, but the center-deck system is somewhat simpler and easier to install and maintain. With the center-deck system two circuits of 56-watt lamps, or one of 94-watt lamps, are used, and with the half-deck lighting 23-watt or 36-watt lamps are usually employed. It has been found that from 2.5 to 3 foot-candles are desirable on the reading plane of the passengers. This plane is considered to have an angle of 45° 3 feet above the floor. With either the center or half-deck lighting where efficient intensive-type reflectors are used, approximately 82 lumens per running foot of car body will supply this illumination. This corresponds to about 10 watts per running foot, or 1.25 watts per square foot of floor area.

Tests have shown that with the ordinary dark-yellow finish of street cars the efficiency of light utilization is approximately 15 per cent where no reflectors are used and 30 per cent with a good direct-reflector system. On one car where the finish of walls and ceiling was white, a utilization efficiency as high as 60 per cent was obtained. One pronounced advantage of the tungsten lamp over the carbon unit for car lighting is that the candlepower changes less on fluctuating voltages. The four tungsten lamps especially developed for railway service are rated at 23, 35, 56, and 94 watts, respectively. The efficiency of the two smaller sizes is 1.34 watts per candle, and of the two larger sizes 1.20 watts per candle. The ultimate saving justifies the rewiring of old cars to enable tungsten lamps and reflectors to be used.

One of the incidental features of street-car lighting is the outside illumination of platforms and signs, more particularly the latter. The largest single item in the cost of maintaining illuminated car-destination signs of the roller type is found in keeping the letters in legible condition. The custom is to retouch the letters by hand, but when necessary to renew a section of canvas and replace the names of the destinations by hand, painting is quite expensive. To reduce this cost of renewal to a minimum, Mr. G. W. Swint, master mechanic of the Nashville Railway & Light Co., Nashville, Tenn., has devised a scheme whereby a 36-name sign may be replaced with a new one at a cost of $1.50 for material and labor. Instead of doing the work by hand, the signs are printed on the canvas by wooden blocks of the hollow-letter type. The blocks were made in the company's shops, and as many prepared as there were destinations. The cost of carving the letters in the white-pine blocks was comparatively low, and their useful life is, of course, unlimited. The complete printing outfit comprises, in addition to the hollow-letter blocks, a section of plate glass by means of which a composition of printer's ink is evenly applied to an ordinary rubber roller, a padded table with clamps to hold the canvas firmly in position, and an old armature core which is used to press the wooden-block type against the cloth. The ink is applied to the block by passing the rubber roller across it, the block is then laid upon the white canvas, and the armature core is rolled once or twice across it.

The quality of printing ink applied to the hollow-lettered panels and the weight of the old armature core cause the ink to penetrate the canvas, giving a longer life than when applied by hand. The names making up a complete set of destinations are printed in series of five to a canvas panel. These panels are sewed together in long strips for the car signs. In case only a portion of this lettered canvas becomes badly soiled, it may be ripped from the rest of the roll and a new panel supplied. The work of printing these signs is so simple that an expert is not required, or even a man specially detailed to do the work. Two men familiar with the operation make eight five-name panels in an hour.

The Peoria (Ill.) Railway Co. has adopted route signs of a novel design on the city cars. To advise the public regarding a new system of car indications, a card map showing the various route lines of street railway drawn to an exaggerated scale, together with the sign indication applying to each, was pasted in each car. A facsimile copy of this card also was published in the daily papers for several weeks.

The sign is a triangular prism built of light structural angles and 18-gauge sheet metal, the base being shaped to fit the contour of the car roof. Two signs are mounted at right-hand diagonal corners of each car, and the right-angle faces of the signs are set parallel to the front and sides of the car. These two faces are 17 inches by 18 inches in size, and take a 12-inch initial letter and 3-inch letters in the printed destination. All letters are perforated with $\frac{5}{16}$-inch holes which permit reflected light from a single 16-candlepower lamp installed inside the sign to illuminate them at night. The interior of the sign is painted white to intensify the indirect letter illumnation, making it possible to read the names easily at 500 feet during either day or night. The lamps in the two signs are in series with the lamps in the car and are controlled by the same switches.

The lettered panels are interchangeable, as guides in the sign frame permit them to be removed and replaced by any other destination sign in case it it becomes necessary to change a car's routing. A complete equipment of sign panels is kept at each car house, and each crew is required to see that the correct indications are in place before the car is taken for a regular run.

These signs are useful not only to residents but to strangers, as they enable the destination of the car to be ascertained more easily.

SIGNALING AND DISPATCHING.

An increased amount of attention has been paid to the subjects of signaling and dispatching on electric railways, including the use of automatic stops, or such devices as the dictaphone; while even the "telegraphone," with its fine running wire to receive magnetically the record of vocal orders, has been under serious consideration in large electric railway systems in cities for "load dispatching" purposes, where it is desirable to know just what instructions have been given from one power plant to another. The main thing, of course, is the control of train movement or the automatic stopping of trains otherwise out of control.

The year 1912 saw a noteworthy development in block signaling, the main features of which may be briefly noted. The problem ceased to be one of the practicability of such a method, and became instead that of the selection and standardization of apparatus. Thus, for example, while the standardization of apparatus unquestionably reduces costs, the necessity for uniform signal "aspects" is actually of greater importance, especially as uniformity in this respect can be accomplished with greater ease when the installation of automatic signals on electric railways is only just beginning than at some later time when large and important roads are fully equipped with widely different types. This necessity is shown in cases where, through operating agreements, several interurban roads are using the same tracks. Each road may be using a special signal "aspect" on its own track so that motormen are hampered by the fact that they have to think in totally different terms at different portions of the route. In consequence of this demand for standardization, the upper left-hand quadrant, three-position arrangement for semaphores has already been approved by the electric railway associations.

The year 1912 was characterized by a remarkable growth of opinion in favor of light signals in which the semaphore arm, practically standard upon steam railroads, was replaced by colored lenses so illuminated as to be visible even in the brightest sunlight. A number of such installations were made during the year, and although the semaphore arm still appears to be considered as the most reliable indication from the standpoint of arrestive effect, the decreased first cost of the light signal, estimated to be in some cases as much as 30 per cent lower than the semaphore, together with the decreased maintenance due to the absence of moving parts, is a good indication that it will be subject to a still wider adoption during the next few years.

Of the different methods of control for signals, the continuous track circuit has maintained its leading position among installations on high-speed lines. This may be due partly to conservatism in following a method so universally used by the steam railroads, although one of the advantages claimed for it, namely, that it indicates broken rails, can hardly be said to apply with much force to electric railways. It has, however, a similar advantage in that it indicates defective bonding by the failure of the signals to clear. The thoroughly demonstrated reliability of the track circuit through many years of experience naturally can not be denied, and it was undoubtedly this feature which influenced the joint committee on block signals of the engineering and transportation and traffic associations at the Chicago convention in 1912 in recommending for high-speed interurban service the use of continuous track-circuit control. The fact that this recommendation was not accepted by the association in convention was indicative of the desire of the delegates to be left free either to accept new devices or else to await the development of systems not sufficiently tried out.

Much attention has been paid to dispatchers' systems, although the number of such installations is hardly comparable with that of the older track-circuit types. On the Piedmont Traction Co.'s lines a selector system controlling semaphore blades has been installed to enable the dispatcher to stop trains for orders which are transmitted by a telephone box attached to each signal mast. The Indianapolis & Cincinnati Traction Co. installed, as the other extreme, an exceedingly complete type in which connection between the dispatcher and the train is made at short sections of third-rail through a shoe on the car. By means of this connection the dispatcher can illuminate either a red or a green lamp in the cab of the train in accordance with his desire to stop the train or let it proceed, although an ingenious interlocking system prevents him from letting two trains proceed against each other.

Various forms of the trolley-contact system have been installed on a number of railways. Their greatly reduced cost offers a strong incentive to installation. In addition, the possibility of introducing a car-counting device by giving the contactor a directional sense makes this system of unusual advantage where permissive signals, allowing cars to follow one another into the same block, are desired. Permissive blocking, however, except for very low speeds, seems to have been regarded with decreasing favor.

As to automatic stops, on the Illinois Traction System a device has been developed by which the air brakes are applied in case a car runs past a home signal set at stop. Such a device is of undoubted value. On the New York, Westchester & Boston Railway the future necessity for automatic stops was considered to be such a certainty that the signal system was laid out in a manner which will permit them to be installed at any time, the overlaps to be effected by the interpolation of additional signals where necessary along the line.

Important legislative action in regard to block signaling developed through an enactment of the general assembly of Indiana. This law became effective on January 1, 1912, and placed with the state railroad commission power to compel the introduction of approved block signals on the railways of Indiana which had sufficient traffic or were surrounded by such conditions as to make block signals necessary. The results of this action seem to have been satisfactory. A very marked increase in mileage of interurban lines protected by signals resulted during the year. It is estimated that 18 per cent of the total electric railway mileage was being equipped, and that all lines coming within the scope of the enactment would be equipped within three years.

Of the large single-track installations made during the year, that of the Washington, Baltimore &

Annapolis Railroad is probably the most interesting. On this road the customary preliminary sections are omitted and each block is made self-contained, extending the full distance between sidings. Light signals set about 1,000 feet inside of the home semaphores take the place of the preliminaries, and all home signals are approached under control. The home signals at each end of the block are controlled by the whole block, but the light signals are controlled only by two-thirds of the block length at the opposite end. As each block is a unit, the movements of a car in one block do not affect those in the next one, and cars need be spaced no more than one block apart. In case two opposing trains pass home-semaphore signals at the same time, they will be stopped by the light signals, which will not clear until one train has backed out of the block.

The attention given to this subject is further emphasized in the report at the annual meeting of the American Electric Railway Association at Atlantic City, N. J., October, 1913. The report stated that during the year the majority of the new installations of block signals on high-speed interurban lines were controlled through continuous track circuits. In view of this fact the committee repeated its recommendation of the previous year, that for high-speed interurban service automatic signals be controlled by the use of continuous track circuits, and that expenditures be concentrated on continuous track circuit control with a cheaper form of indication in preference to a more expensive form of signal and a less reliable control.

For signaling single-track suburban railways with headways between 5 minutes and 30 minutes and speed not exceeding 20 miles per hour, several schemes for trolley-contact signals were submitted, together with drawings of diagrammatic arrangements, according to different arrangements of passing sidings. It has been generally conceded that trolley-contact signaling is well adapted for this type of line. Track-circuit control for this general scheme of signaling has been installed, however, and may be used, possibly with certain limitations. For signaling double-track suburban railways with headways between 1 minute and 10 minutes and speeds not exceeding 30 miles per hour, several schemes for trolley-contact and track-circuit signaling were submitted, including both three-position and two-position signals. All these provide, either by overlaps or by distant signals, means for protecting the rear of a train which may be stopped a short distance beyond any home signal, so that it will not be hit by a following train which overruns the signal in making a stop.

For signaling single-track interurban railways with hourly headway and with speeds from 40 miles per hour to 60 miles per hour, two schemes were submitted. In one of these no track-circuit preliminaries are used, intermediate signals replacing the preliminaries. In the other the track-circuit preliminary is used with a light indicator, if desired, at the beginning of the preliminary, so as to indicate, to a car approaching the siding from the side on which the preliminary is located, the position of the home signal at the siding before it is reached. In both schemes absolute blocking from siding to siding is employed, either semaphores or light signals, or a combination of them, being used.

For signaling single-track interurban railways with 15-minute headways, trains in several sections and speeds from 40 miles per hour to 60 miles per hour, three schemes were submitted. One provides intermediate signals in place of preliminaries, and uses two-position signals, giving absolute blocking for following cars at one-half the distance between sidings. The second provides signals to be of the three-position type, following cars being blocked practically one-half the distance between sidings for following movements and from siding to siding for opposing movements. With this arrangement, both the stop and caution indications are given. With the third arrangement, cars are allowed to follow one another into an occupied block under a permissive indication, the blocking of opposing cars being absolute. Signals in one direction are normally clear, in the other normally danger. A light indicator is used at the beginning of the preliminary section, and a secondary light is used on the signal to provide the permissive feature. Light signals may be used if desired.

For signaling high-speed double-track interurban railways with 5-minute headway, only one scheme was suggested. With this arrangement, semaphore signals operating in three positions are used, the distance between signals being governed by the headway and speed. The operation is the same in either direction. Light signals may be used if desired. Stop and caution signals are displayed behind each car, and cars are able to follow each other as close as the distance between two adjoining signals, the second car in this case running under the caution indication continuously. Continuous track circuits are used with this scheme.

The committee recommended for adoption as standard the following aspects for trolley contact signals:

For a noncar-counting signal for single track, a single red light indicates "Stop: Do not pass contactor." A single green light indicates "Proceed by contactor to operate signal." If green aspect changes to red over yellow on passing contactor, it indicates "Proceed." If red and yellow are displayed on approaching signal, do not pass contactor until this aspect changes to green.

For a car-counting signal for single track, a single red light indicates "Stop: Do not pass contactor." A single green light indicates "Proceed by contactor to operate signal." If green aspect changes to red with a yellow light diagonally below on passing contactor, it indicates "Proceed." But if yellow light changes to opposite side of red, "Proceed under control into block, as block is occupied by car running in same direction as car about to pass under contactor."

It is to be understood that red with staggered yellow on either side indicates "Block occupied with same direction of traffic," and that this permits proceeding past contact device only in case staggered yellow changes from one side to the other, which indicates the recording of the car. Changing from one yellow to the other permits proceeding under control.

For light aspects for car-spacing signals operated by trolley contactors or other forms of end-set device used for double track, a single red light with a white telltale light indicates "Stop." A single green light with no telltale light indicates "Proceed." A single yellow light with no telltale light indicates "Proceed; next signal at stop." For two-position signaling the latter indication is omitted. The aspect called the telltale indicates that the contactor has operated the signals, and in practice it should be located on the next pole beyond the signal.

The report of this committee included an interesting appendix in regard to automatic stops for electric railways, a subject which, owing to accidents of a serious character on steam lines, has received considerable attention. Any historical data concerning the automatic train stop and its development should refer to the system which has been in successful operation on the lines of the Boston Elevated Railway for more than 12 years. This was a modification of an overhead-contact type of automatic stop, providing for the operation by the signal of a rocker shaft lying transversely to the track and equipped with a tripper arm which moved into and out of the path of an arm suspended from the forward end of the car. To this arm on the car was attached a valve which vented the train pipe when operated by the track tripper arm in the event of a train overrunning the signal in the stop position.

In 1903 this system in modified form was introduced on the lines of the Interborough Rapid Transit Co. of New York City, and later on the Philadelphia Rapid Transit System. The modification was of minor importance, however, consisting merely in the operation of the rocker shaft by a pneumatic cylinder separate from the one which operated the signal. The valves of the two cylinders were jointly controlled by the track-circuit relays of the block system.

A few years ago the same system was introduced on the lines of the Hudson & Manhattan Railroad, which were then all in tunnels, and on those of the tunnel and terminal division of the Pennsylvania Railroad across New York City and under the North and East Rivers. In its application to the Pennsylvania tunnels, it was found necessary to meet a condition not previously encountered. Trains ran beyond the tunnels into open country and through towns and across highways where high speeds were permissible. Under these conditions the brakes might be set by contact of the lever of the automatic train-stop valve with loose objects or with snow and ice, and a modified form of tripper arm was developed to overcome this difficulty. The valve is of the plunger type and is mounted between two guards, one in front and one in the rear of the plunger, so that it is protected against operation by any force not acting vertically upward against it.

The use of automatic signals on regular trolley city lines may be noted. The Easton Transit Co. has an important block of single track in Easton, Pa., on Walnut Street, from Northampton to Washington, between Sixth and Ninth Streets. The length of the block is 2,250 feet; running time, about 2½ minutes. The greater part is on a grade a little less than 5 per cent downward toward Northampton Street. About one-third of the distance from Northampton Street there is a branch leading off the single track to Ferry Street, used only by one interurban line. The block is traversed by four lines of cars, each, however, only in one direction: The South Bethlehem Interurban, hourly, eastward only; the Bethlehem Interurban, hourly, westward only (from Northampton Street to Ferry Street); two local lines, namely, Walnut Street and College Hill, 10 minutes' headway, westward only; South Side belt line, 10 minutes' headway, eastward only; thus making 14 cars per hour passing through the block, and amounting to some 280 regular cars per day. During the season 24 cars on the Island Park line return through this block between the hours of 10 and 12 p. m.

Signals have been installed to facilitate movements on this block, superseding the hand signals hitherto used. The signals are controlled through trolley contactors placed two spans in advance of the signal aspect at each end of the block. An additional contactor is placed on the curve from Walnut to Ferry Street connected to clear the signals only, and wired to signal 2. The operation is as follows: The signals are normally neutral, and show no lights or disks. A Walnut Street local, for instance, going up the hill, running under contactor *a*, sets signal 1 at stop, a red light and red disk, thereby preventing an opposing movement down Walnut Street, and signal 2 responds by showing a permissive signal, a white light and white disk. When the car leaves the block under contactor *d* (Washington Street), both signals are restored to the normal neutral. Should, however, a Bethlehem Interurban follow the local, then the signals would not change until the local had passed under contactor *d* and the Interurban had passed under contactor *e*, thus leaving the block clear. In fact, a number of cars might follow into the block in succession, and the signals would not change until the last had left. Similarly, an Interurban returning from Bethlehem, running under contactor *c*, will set signal 2 at stop and signal 1 at permissive, and will clear both signals in leaving the block under contactor *b*. Thus the signals give absolute protection against any opposing movement but permit following movements to be made, warning the motorman, however, that the block is occupied. Any possible shifting movements around the terminals of the block are taken care of by the signals automatically. The signals are kept in the neutral or clear position by power from the trolley line, and the car entering the block opens this normally closed circuit through a revolving or step-by-step switch in the relay, permitting the distant signal to go to the stop position. The movement of the red disk to the indicating position closes a return or answer-back circuit over another line to give the permissive signal to a following car. Thus the stop signal must first be given before the permissive can be displayed, and therein lies its fundamental safety. Failure of power in the trolley line will set all signals at stop.

No batteries are required, nor is the track modified in any way, the signals being lighted and operated by taps from the trolley. The trolley contactors are flexible strips which are wiped by the trolley wheel, which thus makes the contact. The signal box is supported on a convenient iron bracket, the upper part containing the lights and disks, and the lower the oil-immersed relay, or intermediate apparatus for changing the transient current impulses that the car makes in running under the contactor into signal indications.

The Southwest Missouri Railroad operates 75 miles of track, about one-third of which is double track. Cars are run at from 3 to 30 minutes' headway, but the lines upon which service more frequent than 30 minutes is given are double-tracked. For the past 20 years the dispatching of cars on this road has been by telephone, none of the orders being reduced to writing. More recently, however, a new feature was added to the telephonic system by the installation of a dictaphone in the dispatcher's room, with the effect that since then every order given to trainmen by telephone has been duly recorded on the dictaphone and can be reproduced in case of any dispute or misunderstanding. These records are preserved for a period of three days, when they are scraped and the blanks are put back into service. The system is described as highly satisfactory. So far as known, the dictaphone in the company's office in Webb City, Mo., is the first one used in train-dispatching work.

Telephone dispatching.—The use of the telephone in train or car dispatching has become so general a thing as to excite no comment. Some of the installations are quite extensive. A typical case is the equipment of the Oregon Electric Railway in 1913. This railway is an integral part of the great system of railways which reaches from the North Pacific coast to the Great Lakes and the Missouri and Mississippi Valleys, comprising the North Bank Road, the Oregon Trunk, Great Northern, and Northern Pacific Railways, and the Burlington Route. The Oregon Electric line operates from Portland to Eugene, Oreg., and from Portland to Forest Grove, Oreg. The former division traverses the heart of the famous Willamette Valley, which is one of the richest and most productive agricultural portions of Oregon.

The telephone train-dispatching system covers these two divisions. The former is approximately 40 miles while the other is approximately 125 miles in length. There are two train dispatchers, both located at the Hoyt Street Station, Portland.

The apparatus includes two complete dispatcher's equipments comprising key cabinets and 45 calling keys in all besides the telephone sets; and trains are equipped with portable telephone sets for use in communicating with headquarters from points between way stations. Each portable set is furnished with line poles and plugs. The latter are used in connection with 50 type jacks installed at the various sidings along the right of way.

AIR-BRAKE EQUIPMENT.

The extent to which this class of apparatus has increased is shown by the tables in the report, which emphasize the tendency exhibited in the data for 1907. The conditions governing are brought out in an interesting manner in the action of the New York supreme court, appellate division, of July 10, 1913, sustaining the public-service commission of the first district in ordering all passenger cars within New York City that weighed more than 25,100 pounds to be equipped with air brakes. This would appear to be conclusive in many ways, but the review [1] of the evidence and tests by Mr. J. N. Dodd, engineer of the commission, is not accepted by the engineer in charge of the tests for one of the companies most directly affected, who says: "He has carefully eliminated every particle of data that bore in favor of the hand brakes, such as the wet-rail or bad-rail tests, and the reversal stops, and has regarded as available only that which tended to prove his previously determined position. He has also absolutely ignored a great mass of other tests, several hundred in number, the results of every one of which were adverse to his position."

In the course of his discussion of the subject, Mr. Dodd remarks that at first glance it seemed reasonable to suppose that exhaustive tests had been made by some authority to determine the maximum weight of cars which might be operated safely with hand brakes. A long search, however, failed to reveal any such series of tests. When comparative tests had been made by any company or other authority, most of the cars tested had been of the same weight. No thorough, exhaustive test apparently had been made for the purpose of determining the limiting weight of cars which might be safely operated with hand brakes. Moreover, when available records of various tests were examined, they were found to be contradictory and inconsistent. For example, the tests by the New York railroad commission in 1899 on cars weighing about 20,000 pounds showed hand brakes better than air brakes at almost all speeds. On the other hand, tests on the Hanover Street railways, reported to the International Street and Interurban Railway Congress, Munich, 1908, on cars of about the same weight showed air brakes far superior at all speeds.

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[1] Electric Railway Journal, Sept. 13, 1913.

In the course of this search it became apparent that tests do not always furnish a reliable criterion of the relative value of different brakes. They merely state the stopping distance of the car under the particular conditions that obtained at the time of the test. Among these conditions may be mentioned the brake-shoe adjustment, the weight of the car, the condition of the rail, and the human element. Most of these factors vary widely during the course of the day, and each of them may change independently of any of the others. Thus, on account of the wear of the brake shoes, the brake adjustment may change materially even in the course of a single trip. The weight of the car is continually changing, owing to the fluctuations in the number of passengers. The condition of the rail may alter entirely in the course of a few seconds. This change is often such that a visual inspection of the rail fails to reveal its quality. Thus a wet rail may provide an ideal surface for stopping a car quickly, or it may offer the reverse. In the same way, though not to the same extent, the distance in which a car may be stopped on a dry rail varies according to whether the rail is clean or covered with dust or dirt. For this reason it is impossible to be sure that the rail conditions are the same in tests on two different brakes, or that the rail condition at the time of the test represent correctly average rail conditions under which the car must operate throughout the year.

The human element also is extremely variable. In actual service there are many strong motormen, and many who are physically weak; many who are intelligent and mentally alert, and many the reverse; many in fresh physical and mental condition, and many tired from a day's work.

During most tests the motorman usually knows that he is soon to receive the stopping signal and, knowing what he is expected to do, is intent upon doing that thing in the most efficient manner. During such tests, also, the streets are usually bare of traffic, and the motorman's attention is not distracted by other duties, such as making up lost time, keeping a lookout to pick up passengers, and obeying the conductor's signals. Usually a picked motorman is chosen, selected for his general intelligence and interest in his work. The motorman is generally in fresh physical condition, and therefore in good mental condition and to that extent capable of responding to any demands made upon him. The results obtained in service at the close of a long, wearying day's work would be entirely different from the results obtained in any series of tests. It is impossible to devise any series of tests under conditions which even approximate the average conditions existing in actual service because it is impossible to tell what the average of these varying factors may be. Hence it is not wise to place too great reliance upon tests as a method of determining the type of brake which must be used on any type of car.

The census reports for 1902 and 1907 give the following figures relating to cars for city service:

	Cars, total number.	Number equipped with air brakes.	Per cent equipped with air brakes.
1907	83,641	31,684	37.8
1902	66,784	7,905	11.8
Increase	16,857	23,779	....

According to these figures, practically all new cars purchased during this period were equipped with air brakes, and many of the old cars had air brakes added. On the other hand, although these figures show the growing esteem in which the air brake is held throughout the country, they give no indication of the weight of cars so equipped.

More definite information is obtained from a study of the braking practice observed in various cities. It appears that all cars are operated with power brakes in the cities of Cleveland, Detroit, Los Angeles, Milwaukee, Minneapolis, St. Paul, and St. Louis. In addition, all double-truck cars are equipped with power brakes in Chicago, Cincinnati, Indianapolis, Louisville, Omaha, and Seattle, and in the state of New Hampshire. In the city of Denver all new cars purchased are equipped with air brakes and practically all the old ones are so equipped. This evidence is important as showing the opinion on this subject held by managers and municipal authorities throughout the country.

The New York law requires all street railroad companies under jurisdiction of the public-service commissions to report all accidents which occur on their lines. A study was made of these accidents in the first district by the commission of that district to determine what evidence could be obtained from them bearing on the subject of brake equipment.

From the accidents so reported for the years 1909 and 1910, all those caused by the front end of a moving car were selected. These accidents were listed according to the weight of the car. By the use of the average number of cars of each weight operated throughout the year, the figure representing the total number of such accidents listed under each weight of car was reduced to the number of accidents per 100 cars.

The maximum weight of single-truck cars is about 20,000 pounds. The weight of double-truck hand-brake cars used in New York City in 1909 and 1910 varied from 20,000 pounds to about 40,000 pounds. The weight of air-brake cars varies from about 25,000 pounds to about 50,000 pounds. The list of accidents reported for the various weights of cars is given in the following table:

Accidents to Surface Cars Reported to Public Service Commission, First District, during 1910 and 1909.

	Total.	1910	1909	Average per year.
Hand-brake single-truck cars, weight 16,000–20,000 pounds:				
Number of accidents	166	111	55	83
Number of cars	820	765	875	820
Accidents per 100 cars	20.2	14.5	6.3	10.1
Hand-brake double-truck cars, weight 20,100–25,000 pounds:				
Number of accidents	62	42	20	31
Number of cars	281	281	281	281
Accidents per 100 cars	22	15	7.1	11
Hand-brake double-truck cars, weight 25,100–40,000 pounds:				
Number of accidents	651	412	239	326
Number of cars	2,010	2,001	2,018	2,010
Accidents per 100 cars	32.4	20.6	11.9	16.2
Air-brake double-truck cars, weight 25,000–40,000 pounds:				
Number of accidents	212	162	50	106
Number of cars	841	959	723	841
Accidents per 100 cars	25.2	16.9	6.9	12.6
Air-brake double-truck cars, weight 40,000 pounds and up:				
Number of accidents	187	94	93	94
Number of cars	699	704	695	699
Accidents per 100 cars	26.8	13.3	13.4	13.4

The value of such a list lies in great part in the fact that it deals with large numbers. A large number of cars will usually be operated under average conditions. A small number of cars may be and often are operated under special conditions. For example, a small number of cars may be operated in a very congested territory or the reverse, or the daily mileage may be exceptionally large or small. Such criticisms do not usually hold when large numbers are dealt with.

The figures given in the above table suggest the following conclusions:

1. On single-truck cars weighing not more than 20,000 pounds, hand brakes are satisfactory, and no improvement could be obtained by the use of air brakes.

2. On double-truck cars weighing not more than 25,000 pounds the evidence is inconclusive. Although the number of accidents per 100 cars is small, the number of cars is small, so that the record lacks weight.

3. Cars weighing from 25,000 pounds to 40,000 pounds equipped with hand brakes were involved in about 30 per cent more accidents than were an equal number of cars of the same weight equipped with air brakes.

An examination was also made of the number of accidents reported on cars weighing from 25,000 pounds to 30,000 pounds. In this class there were a great many cars, and the record showed even more strongly in favor of air brakes than did the record of the larger class, including cars weighing from 25,000 pounds to 40,000 pounds.

Mr. Dodd held that a more accurate criterion would have been a comparison on a mileage basis—that is, a record of the accidents, say, per 1,000 miles. Air-brake cars, being newer, are more popular with the traveling public than are hand-brake cars. With the same motor equipment the schedule speed of an air-brake car is higher than that of a hand-brake car. Air-brake cars are in much greater favor with the motormen because of their ease of operation. The power consumption of air-brake cars is considerably less than that of hand-brake cars on account of the fact that with hand-brake cars motormen usually operate in congested traffic with the brake partially applied so as to be able to stop the car quickly when necessary, while with the air brake they run free. For all these reasons it appears probable that for cars of the same weight the mileage of cars equipped with air brakes is much greater than that of an equal number equipped with hand brakes. It therefore follows that a record of accidents on a mileage basis would be much more favorable to air brakes than the record given above.

The recommendations of the presiding commissioner were as follows:

1. That all double-truck passenger surface cars in service weighing over 27,000 pounds should be equipped with power brakes and geared hand brakes on or before June 1, 1912. This will give the companies an opportunity during the next six months to equip with power brakes all of their open cars weighing 27,000 pounds and upward, and also their closed cars during the summer of 1912 which will be required to go into service in the autumn.

2. That all double-truck passenger surface cars in service weighing over 25,100 pounds should be equipped with power brakes and geared hand brakes on or before June 1, 1913.

3. That all double-truck passenger cars weighing 25,100 pounds or less should be equipped with geared hand brakes on or before June 1, 1912.

4. That all cars other than passenger cars should be equipped with power brakes and geared hand brakes on or before June 1, 1912.

One of the companies most directly affected by the order had 1,125 cars on which both air brakes and geared hand brakes would have to be provided, and the total cost of the change was estimated at $560,000. It secured a rehearing and conducted a series of tests on the relative stopping distances that could be obtained with air brakes and various makes of hand brakes. The series included tests of five different makes of hand and air brakes adjusted to four different ratios or pressures, tests on three different weights of cars, tests on wet and on dry rail, and tests with and without sand. In most cases the car was stopped by means of the brake and also by reversing the motors. With the air brake the car was stopped by the "service" application and by the "emergency" application. Tests were made on an empty car, on a car loaded with sand to represent a seated load, and on a car loaded to represent a standing load. The car was stopped when running at 5, 10, 15, and 20 miles per hour. Three stops were made at each speed and load, making 36 stops for each complete test of each brake and method of braking.

From these tests an enormous number of data were obtained. "For the sake of simplicity," Mr. Dodd claims, "it was necessary to eliminate from consideration as many as were not essential or for any reason not reliable."

The wet-rail tests were very erratic. In many instances the stops were much longer than the corresponding stops made on the dry rail, and also in many instances they were much shorter. Two consecutive stops, made apparently under identical conditions, would vary from each other in a ratio sometimes as high as four to one. Although operation under bad rail conditions is very important, the results of these wet-rail tests were such that no consistent conclusions could be obtained from them, and they were for that reason disregarded.

The motor-reverse stops were disregarded, for many reasons. In the motor-reverse tests the stop was obtained principally by the motor. It was not a test of the brake. Such a method of braking requires an entirely different procedure in an emergency from that employed in ordinary "service" braking. Consequently, it is probable that the results obtained in these tests by this means of braking were superior to what would be obtained in actual operation, inasmuch as in the tests the motorman knew in advance that he was to stop the car in a certain manner. It also appeared that although reversing the motors often gave better results than stopping by means of the brake, this was the case, as a rule, only at low speeds. At high speeds reverse stops usually gave poorer results than brake stops, and at these speeds the superiority of the brake stops was much more marked than the superiority of the motor stops at low speeds. For these reasons the reverse stops were eliminated from consideration and attention was devoted to the brake stops.

For the purposes of the hearing, the object of the tests was to determine what brake would stop a car in the shortest distance in order to avoid an accident. For this reason the "service" stop was not considered, the brakes being considered solely on an "emergency" basis.

Since the purpose of the tests was to determine the action of the brake in its operation throughout the year, individual stops were disregarded and the average length of stops was the only figure considered.

Summing up his conclusions on the data and tables set forth, Mr. Dodd asserts that to the extent that the tests were reliable as evidence they proved: First, that air brakes properly adjusted are superior to any hand brake tested; second, that in actual service the strain produced in the brake rigging by an air brake is much less than that caused by those hand brakes which showed themselves most efficient; third, that in an emergency the possibility of skidding is much greater with a hand brake than with an air brake, and that, therefore, the results obtained in actual service with a hand brake would be inferior to those obtained with an air brake. The result of the tests, therefore, was to confirm the commission in its previous opinion. In the final order on the motion, made June 21, 1912, section 4 of the order, relative to service cars, was rescinded and increased time was given to the companies to comply with the other sections, but no change was made in the weights affected.

A curious example of the onerous obligations that may be thrown on street railway companies at any time in the operation of their mechanical departments is afforded by the air-brake law passed by the legislature of Ohio in 1910, requiring all electric cars to be equipped with air brakes of a certain type. The brake defined was one which would be capable of applying to all the brakeshoes and wheels of an electric car a maximum permissible braking pressure and of automatically reducing such braking pressure as the speed of the car decreased. Under the law, 50 per cent of all electric cars in Ohio had to be so equipped prior to January 1, 1911, and 75 per cent prior to January 1, 1912. The law provided a penalty of $100 for each violation of the act, the penalty to be recovered in a suit to be brought by the prosecuting attorney of the county where such violation occurred. Moving under this act, the prosecuting attorney of Jefferson County, Ohio, brought suit against the Tri-State Railway & Electric Co. and the Steubenville & East Liverpool Railway & Light Co. in the court of common pleas, No. 2, of Jefferson County, before Judge Shotwell. The defense was that there was no brake such as the public-service commission of Ohio would approve, and that there was no air or electric brake or apparatus capable of applying to all the brakeshoes and wheels of cars a maximum permissible braking pressure and of automatically reducing this pressure as the speed of the car decreased.

In his opinion Judge Shotwell stated that the statute was evidently passed with the idea of requiring the equipment of cars with a patented brake. Among the witnesses at the trial was the patentee. Testimony was brought out that a car equipped with his brake had been in use in Dayton while the bill was under consideration by the legislature. He had sold his interest in the patent to a company in Indianapolis, but acknowledged that the brake was not being manufactured. The factory where the brake had been made was devoted to repair work in other branches of mechanical engineering. For a number of years he had made no further effort to develop the brake. As a result, the court declared that there could be no dispute that such a brake was not on the market, that nobody was making it or selling it, and that no one could buy it.

One of the witnesses for the defense, Mr. Thomas Elliott, chief engineer, Cincinnati Traction Co., said that he had made an examination of the brake and considered it worthless for the purpose of attaining the result claimed. Mr. R. N. Henning, superintendent of motive power, Indiana Union Traction Co., testified that the brake was a failure and would not operate.

Witnesses for the plaintiff consisted of a conductor and a motorman on one of the local lines, who said that they had seen a brake of the kind in Chester, W. Va., but on further examination acknowledged that they knew nothing about the technical construction of brakes and did not know whether such a brake could be used on the East Liverpool lines. The existence of such a brake at Chester was denied by witnesses for the defendant.

Another witness was formerly the member of the state legislature who had introduced the bill. He testified that by trade he was a decorative painter and that he had no special knowledge of railway operation or the construction of brakes. He said that during the session of the legislature in 1910 he had met the patentee, had adopted his ideas in regard to the practicability of the brake, and had embodied them in the bill introduced by him in the legislature.

The court then carefully reviewed the legal situation which occurs when a legislature passes a statute which can not be enforced, and, after quoting various precedents, concluded that the law must be considered to be inoperative. Hence there was a finding in favor of the defendant.

ELECTRIFICATION OF MAIN LINES.

The progress made in the electrification of main lines of steam railroads during the last five-year period is quite notable. The data as to conditions existing in 1912–13 and to be worked out in 1914 have been compiled in a very helpful manner by Mr. E. P. Burch, of Minneapolis. The table given herewith, as will be seen, is based on a group of 10 roads in regard to each class of work.

NAME OF RAILROAD.	Miles of road.	Miles of track.	Number of locomotives.	Explanation, or name of division.
Principal main-line electrifications in service:				
New York, New Haven & Hartford	88	500	100	New York to New Haven and switching yards.
Spokane & Inland Empire	168	187	12	Main line; excludes local lines.
Butte, Anaconda & Pacific	27	90	17	Largely mine switching.
French Southern	165	205	16	Partly equipped.
Baden State	10	31	34	Basel-Säckingen.
Prussian State	19	50	13	Dessau-Bitterfeld.
Italian State	104	156	84	Valtellina, Giovi, and Savonna lines.
St. Polten-Mariazell	63	68	14	
Ratische Mountain	46	48	11	
Bernese Alps	52	55	16	Lotschberg line.
Principal terminal or passenger-service electrifications in service:				
New York Central	50	240	47	Terminal service; no freight service.
Pennsylvania	15	72	35	Terminal service; no freight service.
Long Island	100	250	0	Motor-car trains only.
West Jersey & Seashore	75	150	0	Motor-car trains only.
New York, Westchester & Boston	19	63	0	Motor-car trains only.
Southern Pacific	50	100	0	Motor-car trains only, largely on Oakland streets.
Metropolitan Railway, London	35	70	20	Main line and suburban trains.
London, Brighton & South Coast	60	160	0	Motor-car trains only.
Paris-Orleans	14	46	11	Main line and suburban trains.
Hamburg-Ohlsdorf	17	41	0	Motor-car trains only.
Main-line electrifications to be completed in 1914 and 1915:				
Norfolk & Western	30	85	25	Bluefield-Vivian division.
Pennsylvania	20	90	0	Philadelphia suburban.
Canadian Pacific	30	43	4	Rossland-Castlegar grades.
Chicago, Milwaukee & Puget Sound	113	168	14	Rocky Mountain division.
North Eastern, England	18	44	10	Freight service.
Swiss Federal	93	100	20	Chiasso-Lucerne section of St. Gotthard division.
Swedish State	80	93	13	Kiruna-Riksgränsen division.
Prussian State	81	124	44	Lauban-Königszelt division.
Italian State	32	60	16	Milan-Lecco division.
Vienna-Pressburg	42	50	8	Main-line service.

Steam railroad electrification, in one sense, is almost as old as the electric railway itself,[1] for among the first lines to be electrified were the dummy roads in the suburbs of the larger cities and the shorter steam railroad branches which had become part of urban traction systems.

Baltimore & Ohio Railroad.—It is an interesting coincidence that the Baltimore & Ohio Railroad, which in 1828 placed in service the first American-built steam locomotive on its initial 3 miles out of Baltimore, should also have been the pioneer user of heavy electric locomotives. Its Belt Line tunnel at Baltimore, comprising 7.4 miles of single track, was electrified on the third-rail system in 1895 to eliminate ferriage and give the railroad direct entrance to Baltimore.

New York, New Haven & Hartford Railroad.—The New York, New Haven & Hartford Railroad, which holds the lead in length of electrified track, entered the electrification field in 1895, when it equipped with electric power for direct-current overhead operation a total of 16.8 miles of single track between Nantasket Beach and Pemberton, Mass., on a peninsula about 10 miles southeast of Boston. This line is operated with electricity only in summer.

The company's first heavy interurban electrification, and the first undertaken by any trunk line in the United States, was the equipment, in 1902, of its Providence-Warren-Bristol-Fall River branch with the 550-volt, direct-current, simple overhead system. It is 38.5 miles in length, measured as single track, and consists of a double track from Providence to Warren, a single track from Warren to Bristol and Fall River, respectively, sidings at Providence, etc. The service is of standard interurban character and includes the handling of baggage. Electrification of this line made it possible to give a faster schedule despite an increase in the number of stops made by local trains.

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[1] Electric Railway Journal, June 7, 1913.

During 1907 the New Haven company added to its branch electrifications the Middletown-Berlin-Meriden and Hartford-Vernon-Melrose lines in Connecticut. The construction on the Middletown-Berlin section, 10.4 miles long, and on the Middletown-Meriden section, 7.2 miles long, is of 600-volt, direct-current, plain overhead type. These sections were electrified to give more profitable feeders for the trunk lines and to build up the towns served by providing connections with the local street cars.

The Vernon and Melrose lines follow the tracks of the Hartford street railway system of the Connecticut company for 2.5 miles to East Burnside, where the cars are deflected to the steam railroad right of way from Buckland, Manchester, and Talcottville to Vernon Junction, a distance of about 16.8 miles, single track. At Vernon Junction the line swings to the north and passes to Rockville and Melrose over single-track branches totaling 14.7 miles in length. The electrification of these lines made it possible to bring passengers into the business section of Hartford and to improve the headway through the operation of single cars.

In addition to these direct-current electrifications, the New Haven company's tracks between Middletown and Cromwell, Tafts and Central Village, etc., carry trolley cars of its subsidiary, the Connecticut company, besides the regular steam service.

The 11,000-volt, single-phase, 25-cycle main-line electrification of the New York, New Haven & Hartford Railroad now in operation comprises 21.5 miles of route, or 109.3 miles of single track, between Woodlawn at the New York City line and Stamford; and the Harlem River branch has been completed with 63.4 miles of main line and 78 miles of yard track, a total of 141.4 miles of single track. The main-line electrification for the 41 miles between Stamford and New Haven now nearing completion will comprise 170 miles of main-line track and 40 miles of yards and sidings, or 210 miles in all. The board of directors has approved the electrification of the four-track main line between Providence and Boston, a distance of approximately 50 miles. This affects 196 miles of main-line track and 20 miles of yards and sidings, a total of 216 miles.

The company also operates a single-phase cross-country line of light catenary type between Stamford and New Canaan, comprising 7.7 miles of single track. This road carries electric passenger traffic and steam freight, the latter being handled at night.

On May 27, 1911, the Boston & Maine Railroad placed in service the Hoosac Tunnel, which had been electrified for 11,000 volts, 25 cycles, single phase, in conformity with the practice of the New York, New Haven & Hartford Railroad.

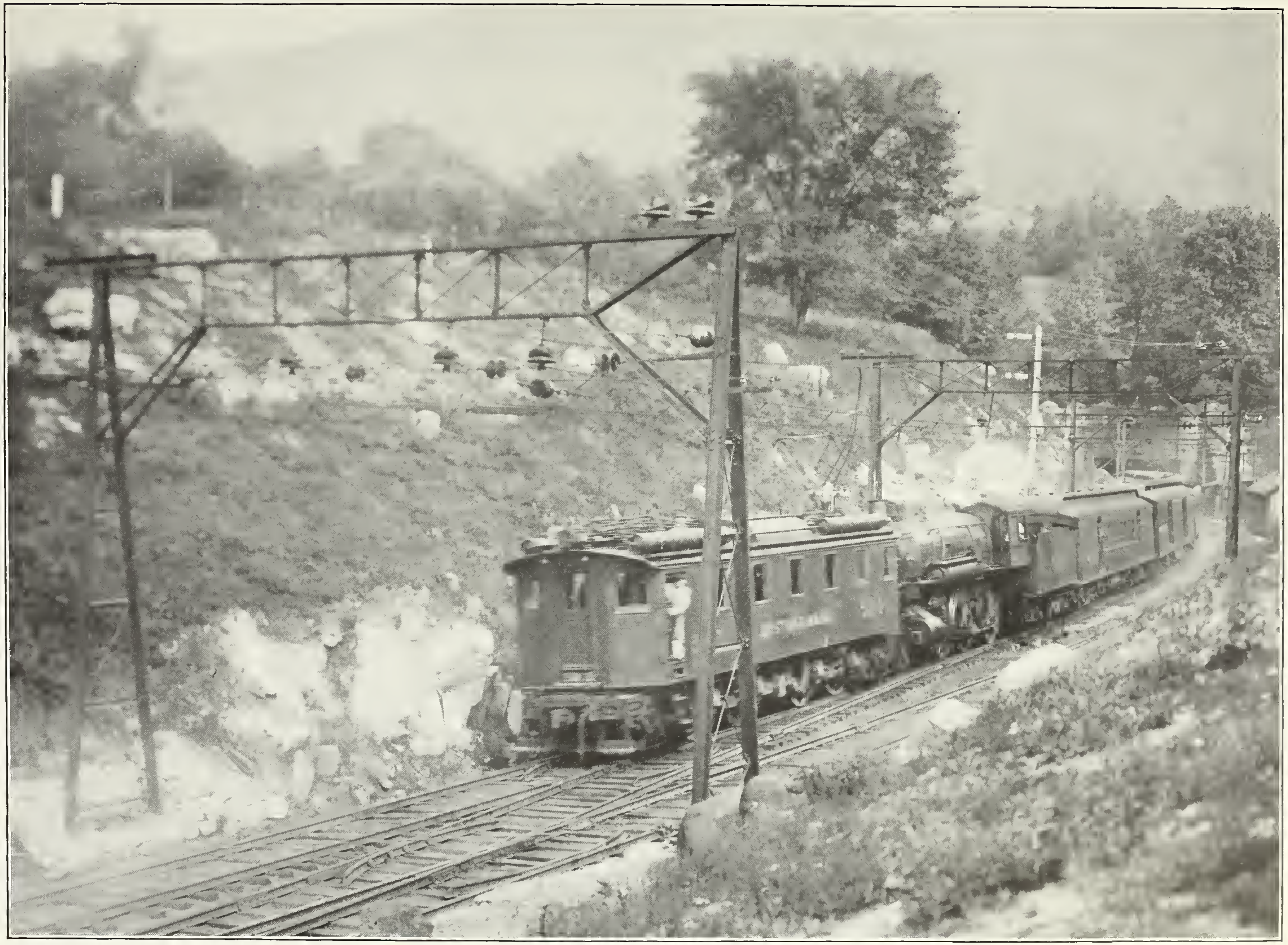
The New York Central and New Haven electrifications were accelerated by the compulsory conversion of the joint viaduct and tunnel entrance to the Grand Central Station via Park Avenue, New York. Unlike the alternating-current, direct-current electrification of the New Haven company, the New York Central equipment is direct-current, third-rail throughout. The latter electrification comprises two lines out of New York City—the Harlem division to North White Plains, 24.4 miles northeast, and the Hudson (main line) division to Harmon, 34 miles north of New York, a total of 234.4 miles of single track. The New York Central & Hudson River Railroad has no immediate plans for additional main line work, but a plan to electrify its freight entrance along the Hudson River in New York City is being considered by the railway company and a committee of the board of estimate and apportionment of New York.

The electrification of the Detroit River tunnel, 19.2 miles of single track, was completed in October, 1910, by the Michigan Central Railroad, a subsidiary of the New York Central & Hudson River Railroad. This is a 650-volt, direct-current, third-rail line.

The Oneida Railway is a 600-volt, direct-current, third-rail line, comprising 44 miles of route, or 118 miles of single track. It is an electrification of the main line of the West Shore Railroad between Utica and Syracuse, N. Y. The passenger cars operated by the Oneida Railway over this section also are run over the tracks of the Utica and Syracuse street railway systems, which, like the West Shore and Oneida companies, are controlled by the New York Central & Hudson River Railroad. The regular through steam service of the West Shore Railroad is still maintained over this section.

Electrification of the suburban lines of the Long Island Railroad, controlled by the Pennsylvania Railroad, was begun about 1903, the first electric trains being operated on the Atlantic Avenue division in July, 1905. The electrification was due to the reconstruction of this outlet from Brooklyn as a subway and elevated line, to the desire to encourage suburban and seashore travel, and to the necessity for greater terminal capacity in a section where property values were high. The conversion of all parts of the suburban system for third-rail, 600-volt operation has not yet been completed, but the electric lines now total 1,868 miles of single track.

During 1910 the Pennsylvania Railroad completed its New York terminal, comprising 98.4 miles of direct-



LINE CONSTRUCTION, HOOSAC TUNNEL ELECTRIFICATION, BOSTON & MAINE R. R.

(Face p. 402.)

current, third-rail construction from Manhattan transfer station opposite Newark to Long Island City, via a new route to Bergen Hill and through tunnels under the Hudson River, Manhattan Island, and East River. By arrangement made in 1911 with the Hudson & Manhattan Railroad, cars of the latter company are operated electrically over the right of way of the Pennsylvania Railroad between Newark and Jersey City.

The West Jersey and Seashore division of the Pennsylvania Railroad between Camden (opposite Philadelphia) and Atlantic City comprises 150.3 miles of 700-volt, direct-current, third-rail construction. This electrification was due chiefly to the desire to encourage seashore travel on high-speed trains. The electric service was opened September 18, 1906.

The route of the approved Philadelphia-Paoli electrification covers a distance of 20 miles. This line is to form the beginning of a general electrification of the Pennsylvania's lines in and around Philadelphia. The length of the electrification, measured as single track, will be approximately 90 miles, depending on the number of sidings converted.

In June, 1907, the Erie Railroad completed the electrification of its Mount Morris division between Rochester, Avon, Geneseo, and Mount Morris, N. Y., a route distance of 34 miles, equivalent to 40 miles of single track. This line, which is of interurban passenger character, is operated at 11,000 volts, 25 cycles, single phase, with Niagara power.

During 1911 the Southern Pacific Railroad converted 96 miles of suburban steam track in and about Oakland, Alameda, and Berkeley, Cal., to overhead 1,200-volt, direct-current operation.

The electrification of the Grand Trunk Railway, as carried out in 1908 under the name of the St. Clair Tunnel Co., comprises 4 miles of tunnel track at Port Huron, Mich., operated at 3,300 volts, 25 cycles, single phase.

The electrification of the Great Northern Railway's Cascade Tunnel, between Leavenworth and Skykomish, about 100 miles east of Seattle, was completed in July, 1909, for 3-phase, 25-cycle, 10,000-volt operation. This is the only 3-phase line in the United States. It has 6 miles of single track, including the approaches. The distance between Leavenworth and Skykomish, the terminals of the completed 3-phase electrification, is 57 miles. The line was electrified to eliminate smoke troubles and increase its capacity.

This company is also considering the electrification of a 530-mile line between New Rockford, N. Dak., and Lewistown, Mont., for which roadbed and other construction contracts have been awarded. In this case electrification is favored because of the poor coal and water conditions for locomotives.

The Chicago, Milwaukee & Puget Sound Railway has contracted for hydroelectric power to operate its line from Harlowton, Mont., to Avery, Idaho, a distance of nearly 440 miles. It is probable that a 2,400-volt direct-current system will be used. Avery is 2,495 feet, Harlowton 4,163 feet, and the intermediate town of Deer Lodge 4,520 feet, above sea level. The distance between Avery and Deer Lodge, the terminals of the proposed initial electrification, is 211.5 miles, and between Avery and Harlowton 439.3 miles, all single track.

The Denver, Rio Grande & Western Railway has decided to electrify one 114-mile mountain division. The distance between Helper and Soldier Summit, which are to be the terminals of the initial electrification, is 29 miles, and from Helper to Salt Lake City 114 miles. Helper is 5,840 feet, Soldier Summit 7,454 feet, and Salt Lake City 4,224 feet, above sea level.

The latest mountain electrification is that of the Norfolk & Western Railway for the heavy coal-carrying line between Vivian and Bluefield, W. Va., comprising 30 miles of route, or 75 miles of single track.

Butte, Anaconda & Pacific Railroad.—In view of the many features of importance pertaining to the electrification of this line, reference to some of the details will be of interest. The Butte, Anaconda & Pacific is credited with being the first steam road operating both freight and passenger service to electrify its lines purely for reasons of economy. The special factors, such as terminal and tunnel operation or rapid suburban service, which have been the determining considerations in a number of steam railway electrifications, were not present in this case. This is also the first line to use 2,400 volts direct current into the trolley. During the first seven months, the line made approximately 201,000 miles and hauled about 2,365,000 tons of ore. The steam locomotive crews easily acquired proficiency in handling the electric locomotives; in fact, two or three days' instruction from a competent electrical man was ordinarily sufficient. The change from steam to electricity was made without any change in the personnel of the train crews and without any delays or alterations in the schedule. The engineers, without exception, have expressed themselves as pleased with the easy operation of the locomotives. The locomotives have been maintained by the regular shop force with the assistance of one man experienced in electrical apparatus.

The Butte, Anaconda & Pacific is essentially an ore-hauling road, the freight traffic from this source originating at the copper mines located near the top of Butte Hill. From the mines, the ore trains are lowered down the mountain a distance of 4½ miles to the Rocker yards, a few miles west of the city of Butte. At this point, new main-line trains are made up for transportation to the smelters at Anaconda. The main-line division extends for a distance of about 20 miles through a rough mountainous country. At East Anaconda, the main-line trains are broken up and hauled up Smelter Hill to the stock bins, where each car is run over the scales and weighed. The eastbound traffic consists in returning empty cars to the mines and the transportation of copper ingot to the Butte yards, where it is shipped over other roads to refineries. The electrified lines extend from the Butte Hill yard to the smelter, a distance of 32 miles. There are numerous sidings, yards, and smelter tracks that have been equipped with overhead trolley, making a total of about 95 miles of single track.

Between the cities of Butte and Anaconda, which are located at the ends of the electrified portion of the system, there is considerable local traffic, both passenger and freight. The city of Butte and vicinity have a population of about 65,000 and Anaconda about 10,000. At Butte, the Butte, Anaconda & Pacific connects with the Great Northern, the Northern Pacific, and the Chicago, Milwaukee & St. Paul; and at Silver Bow, about 6 miles from the city, connection is made with the Oregon Short Line.

The maximum curve on the system is 20°, which occurs on the Butte Hill line. The locomotives are designed with sufficient flexibility to take a curve of 31° at slow speed. Four passenger trains each way per day are operated between Butte and Anaconda. Single locomotives are used, hauling trains of from three to five passenger and baggage cars.

The energy for the operation of the electric trains is purchased from the Great Falls Power Co., Great Falls, Mont. The power is stepped up to 102,000 volts for transmission to the transformer substation at Butte, a distance of 130 miles, over two separate parallel lines constructed on the same right of way. An extension of the system transmits power at 60,000 volts to a second transformer station at Anaconda, 26 miles farther on. The two existing substations at Butte and Anaconda were used to house the 2,400-volt motor-generator sets required for operating the electric trains, so that no additional buildings had to be constructed for this purpose. The energy is received by two 1,000-kilowatt, 3-unit motor-generator sets in each substation. These units operate continuously 24 hours per day, seven days in the week, to supply the necessary current for train operation. Each set consists of a 3-phase, 60-cycle, 1,450-kilovolt-ampere, synchronous motor operating at 720 revolutions per minute, direct-connected to two 500-kilowatt, 1,200-volt generators, insulated to operate in series for 2,400 volts. The generators are compound-wound and have both commutating poles and compensating pole face windings. They will carry three times the normal load for periods of five minutes, as well as the usual 50 per cent overload for two hours.

An automatic voltage regulator is used to maintain an approximately constant voltage at the terminals of the motor by power-factor regulation. The motors are protected against overload by inverse time-limit relays, which are set to open at four times the normal load. These relays have been adjusted to open under a sustained overload in about two seconds, and upon short circuit their action is practically instantaneous. Excitation for the generating units in each substation is obtained from two induction motor-driven sets, rated at 50 kilowatts each at 125 volts.

The 2,400-volt switchboards for controlling these sets are the first direct-current railway switchboards to be constructed for this high voltage. They are similar to the standard 600-volt types, but have increased insulation and special provisions for interrupting the 2,400-volt current. The circuit breakers and switches are arranged for remote control, and all the apparatus on the panels is provided with ample insulation to insure safety to operators. The 2,400-volt circuit breakers and switches are installed on separate panels above and back of the main panels, and are operated by connecting rods from handles mounted on the front of the main switchboard. The breakers are equipped with special magnetic blowouts and arc chutes, and provision is made for automatically inserting a high resistance in the generator field at the same instant the main circuit breakers open, thus reducing the generator voltage.

The overhead construction is designed for pantograph trolleys. The No. 0000 grooved copper trolley used over all tracks is supported by an 11-point catenary suspension from a stranded steel messenger cable. The hanger used on the straight-line construction is a rolled-steel strap looped over the messenger wire. The section breakers were designed for the 2,400-volt service, and at six points insulated crossings are necessary at the intersection of the 2,400-volt trolley with the 600-volt trolley of the city system. On the main line a very simple section insulator is used. This is made by paralleling the two trolley wires from the ends of the two sections at a suitable distance for insulation, so that the pantograph bridges the two circuits for a short distance, thus avoiding interruption of the power supply to the locomotive. The construction in the yards and sidings is simplified by paralleling the trolleys from the side-tracks for a short distance along the main line. This avoids the use of switch plates or similar devices. At some of these junction points the pantograph engages as many as six trolley wires at the same time.

The trolley wire is reinforced between the substations with two 500,000-circular-mil bare copper cables tapped to the trolley at intervals of 1,000 feet. A No. 0000 negative return wire is also installed between Rocker and East Anaconda. The wire is carried on the trolley poles and is connected to the cross bonds at intervals of 1,000 feet. The substations are normally connected together by these feeders, allowing an interchange of current. In emergency, either station can supply current to the entire system.

The locomotive equipment consists of seventeen 80-ton units, 15 for freight and 2 for passenger service. The freight locomotives are geared for slow speed and are operated in pairs for the main line service. The maximum free-running speed is 35 miles per hour. The two passenger locomotives are of the same construction as the freight units, but are geared for a maximum free-running speed of 55 miles per hour. A speed of 45 miles per hour is made with three passenger coaches on a straight, level track. These locomotives are of the articulated double-truck type with all the weight on the drivers. The cab contains an engineer's compartment at each end and a central compartment for the control apparatus. The central channels forming a part of the underframe are inclosed and are utilized as a distributing air duct for the forced ventilation of the motors. The air is conducted through the center pins, which are hollow, into the truck transoms and thence to the motors. The motors are of the commutating-pole type, wound for 1,200 volts and insulated for 2,400 volts, and provided with forced ventilation. The gear reduction on the freight locomotive is 4.84, and on the passenger locomotive 3.2. The double-unit, 160-ton locomotive is capable of giving a continuous sustained output of 2,100 horsepower. The motors are connected to the driving wheels by twin gears similar to those used on the Detroit River Tunnel, the Baltimore & Ohio, and the Great Northern locomotives.

The control equipment is multiple-unit, operating the four motors in series and in series-parallel. The two 1,200-volt motors are permanently connected in series. The controller provides ten steps in series and nine in series-parallel. The transition between series and series-parallel is effected without opening the motor circuit, and there is no appreciable reduction in tractive effort during the change. The transfer of circuits at this point is made by a special change-over switch, which is operated electropneumatically. The 2,400-volt contactors are operated from the 600-volt control circuit, and are specially constructed to separate the 2,400-volt parts from the coils and interlocks which carry the 600-volt current. The necessary insulation is obtained by large clearances and by the use of porcelain and mica insulation. The armature is connected to the contact lever by a wooden rod. The contacts, magnetic blow-out, and arc chutes are also especially designed to rupture the 2,400-volt arc.

Current is collected by overhead roller pantographs operated by compressed air. A 2,400-volt insulated bus line runs along the center of the cab roof. These bus lines are connected together by couplers between the two freight units, so that the current may be obtained from either one or two collectors.

The principal data and dimensions applying to the locomotives are the following:

Length inside of knuckles, 37 feet 4 inches.
Length over cab, 31 feet.
Height over cab, 12 feet 10 inches.
Height with trolley down, 15 feet 6 inches.
Width over all, 10 feet.
Total wheel base, 26 feet.
Rigid wheel base, 8 feet 8 inches.
Track gauge, 4 feet 8½ inches.
Total weight, 160,000 pounds.
Weight per axle, 40,000 pounds.
Wheels, steel tired, 46 inches.
Journals, 6 inches by 13 inches.
Gears, forged rims, freight locomotives, 87 teeth.
Gears, forged rims, passenger locomotives, 80 teeth.
Pinions, forged, freight locomotives, 18 teeth.
Pinions, forged, passenger locomotives, 25 teeth.
Tractive effort at 30 per cent coefficient, 48,000 pounds.
Tractive effort at one-hour rating, 30,000 pounds.
Tractive effort at continuous rating, 25,000 pounds.

Classification of work done.—A very complete survey of work done, conditions, and apparatus was furnished in a paper read before the Canadian Society of Civil Engineers, in December, 1913, by Mr. A. H. Armstrong, the well-known American expert, in which he discussed the methods of electrification and their actual application.

The electrical engineer has perfected several types of locomotives and different methods of distributing electric power to them, thus giving rise to what are known as several different "systems of operation." The term "system" is generally applied to the combination of locomotive and trolley or third-rail distribution, as the matter of power generation and transmission is common to all. The three systems considered for main-line electrification are as follows: Single phase, alternating; split phase, alternating; and high voltage, direct current.

The single-phase commutating motor has been in operation upon interurban electric railways for some years, said Mr. Armstrong, and a study of the history of these installations reveals some of the fundamental reasons why this type of motive power has not been more generally adopted. It has been found that the initial expense and cost of upkeep of rolling stock equipped with single-phase commutating motors is fully double that of cars having the same seating capacity and equipped with direct-current motors. No new installations have been made for the past three years, and the several single-phase roads are being changed over to direct current as fast as financial conditions will permit. The single-phase installations are listed in the following table; and on those roads whose names are preceded by asterisks the single-phase motors have been replaced with the direct-current type:

SINGLE-PHASE RAILWAY INSTALLATIONS IN UNITED STATES AND CANADA.

NAME OF RAILWAY.	Year.
Indianapolis & Cincinnati Traction Co.	1904
*Atlanta Northern Railway	1905
*Illinois Traction system	1905
Long Island Railroad—Sea Cliff division	1905
San Francisco, Vallejo & Napa Valley, California	1905
*Warren & Jamestown Street Railway	1905
Westmoreland County Traction, Derby to Latrobe, Pa	1905
Spokane & Inland Empire Railroad	1906
*Toledo & Chicago Railway	1906
*Anderson Traction Co., South Carolina	1907
Erie Railroad	1907
Fort Wayne & Springfield Railway	1907
*Milwaukee Electric Railway (interurban division)	1907
New York, New Haven & Hartford Railroad	1907
*Pittsburgh & Butler Street Railway	1907
Richmond & Chesapeake Bay Railway	1907
Windsor, Essex & Lake Shore Electric Railway	1907
*Baltimore & Annapolis Short Line	1908
Chicago, Lake Shore & South Bend Railway	1908
Colorado & Southern: Denver & Interurban Railroad	1908
Grand Trunk Railway: Sarnia-Port Huron Tunnel	1908
Hanover & York Railway, Pennsylvania	1908
Shawinigan Railway, Quebec	1908
Visalia Electric Railway, California	1908
*Washington, Baltimore & Annapolis Electric Railway	1908
Rock Island Southern: Rock Island to Monmouth	1910
New York, Westchester & Boston Railway	1911
Boston & Maine: Hoosac Tunnel	1911

The introduction of the single-phase system was a result of the success of suburban and interurban electric railway operation and the extension of these lines over large areas, thus bringing into prominence the question of economical power distribution. It was recognized that a voltage higher than the commonly accepted standard of 600 volts was desirable upon the trolley in order to minimize the cost of installing feeder copper and substations. While the single-phase motor was being developed and installed upon interurban railways, careful attention was also being given to the question of the possibility of using direct-current motor equipments at higher voltages, and this resulted in the first 1,200-volt railway installation, on the Indianapolis & Louisville Traction Railway, operated in 1907. The success attending this operation led to other similar installations at both 1,200 volts and 1,500 volts, until it is now generally recognized, Mr. Armstrong asserted, that the high-voltage, direct-current system is without a competitor for all classes of suburban electric railways. It was a safe prediction to make, he stated, that no more single-phase motor equipments will be placed in operation in this country on new roads unless these roads virtually form extensions of existing systems.

The following table gives a list of the several high-voltage, direct-current installations in the United States and Canada:

HIGH-VOLTAGE, DIRECT-CURRENT RAILWAY INSTALLATIONS IN UNITED STATES AND CANADA.

NAME OF RAILWAY.	Voltage.	Number of equipments.	DATE.	
			Month.	Year.
Indianapolis & Louisville Traction Railway Co., Scottshurg, Ind.	1,200	13	October	1907
Central California Traction Co., Stockton, Cal.	1,200	22	June	1908
Pittsburgh, Harmony, Butler & New Castle Railway, Eidenau, Pa.	1,200	30	July	1908
Washington, Baltimore & Annapolis Electric Railway, Baltimore, Md.	1,200	47	February	1910
Milwaukee Electric Railway & Light Co., Milwaukee, Wis.	1,200	32	March	1910
Aroostook Valley Railway Co., Presque Isle, Me.	1,200	6	July	1910
Oakland, Antioch & Eastern Railway, San Francisco, Cal.	1,200	25		1910
Southern Cambria Railway Co., Johnstown, Pa.	1,200	10		1910
Shore Line Electric Railway Co., Sayhrook, Conn.	1,200	22	September	1910
Southern Pacific Railway (Oakland, Alameda & Berkeley division), Cal.	1,200	82	April	1911
Fort Dodge, Des Moines & Southern Railway, Boone, Iowa.	1,200	29	September	1911
Southwestern Traction & Power Co., New lheria, La.	1,200	3	May	1912
Oregon Electric Railway, Portland, Oreg.	1,200	72	July	1912
Davenport & Muscatine Railway Co., Davenport, Iowa.	1,200	7	August	1912
Kansas City, Clay County & St. Joseph Railway, Kansas City, Mo.	1,500	22	June	1913
Piedmont Traction Co., Charlotte, N. C.	1,500	43		1913
Nashville-Gallatin Interurban Railway, Nashville, Tenn.	1,200	6	April	1913
Butte, Anaconda & Pacific Railway, Butto, Mont.	2,400	17	June	1913
United Railways Co., Portland, Oreg.	1,200	8	June	1913
Southern Traction Co., Dallas, Tex.	1,200	30	October	1913
Pittsburgh & Butler Railway, Pittsburgh, Pa.	1,200	13		1913
Pacific Electric (San Bernardino division), Los Angeles, Cal.	1,200	54	Building	
Tidewater Southern Railroad, Stockton, Cal.	1,200	4		1913
Portland, Eugene & Eastern Railway, Portland, Oreg.	1,500	38	Building	
Southern Illinois Railway & Power Co., Harrishurg, Ill.	1,200	5	September	1913
Jefferson County Traction Co. (Eastern Texas Electric Co.), Beaumont, Tex.	1,200	7	Building	
St. Paul Southern Electric Railway, St. Paul, Minn.	1,200	5	Building	
Michigan United Traction Co., Jackson, Mich.	2,400 1,200	20 40	Building Building	
Canadian Northern Railway, Montreal, Canada.	2,400	14	Building	
Canadian Pacific Railway, Rossland, British Columbia.	2,400	4	Building	

All of the foregoing roads in service are operating with the highest degree of success and no change of type of equipment has been made or contemplated.

The elimination of the single-phase motor as being unsuitable for the equipment of light electric railways has an important bearing upon the selection of systems for main line electrification. The limitations of the single-phase motor that lead to its failure in the interurban railway field do not appear to be lessened when it is considered for locomotive equipment, with the result that it is in use on but three of the twelve roads that are truly representative of electrified steam roads operating large electric locomotives.

There are other electrified steam lines, but the service on them more nearly approaches that of high-class electric interurban railways. There are also interurban systems where electric locomotives of considerable capacity are operated, but the class of service on such systems does not approach the exacting demands of main line passenger and freight operation.

The following table gives a list of converted steam lines on which the service consists of hauling main line passenger and freight trains behind electric locomotives of large capacity. An asterisk preceding the name of a road indicates that the work is under construction.

Main Line Electrification—United States and Canada.

INSTALLATION.	Year.	Type of locomotive.	System.	Voltage.
St. Clair Tunnel	1908	Geared	Single-phase alternating	3,300
New York, New Haven & Hartford.	1907	Gearless	Single-phase alternating	11,000
Hoosac Tunnel	1911	Geared	Single-phase alternating	11,000
Cascade Tunnel	1909	Geared	Three-phase alternating	6,600
*Norfolk & Western	1914	Geared, side rod.	Split-phase alternating	16,500
Baltimore & Ohio Tunnel.	1895	Geared	Direct current	600
New York Central	1906	Gearless	Direct current	600
Detroit Tunnel	1910	Geared	Direct current	600
Pennsylvania Terminal.	1910	Gearless, side rod.	Direct current	600
Butte, Anaconda & Pacific.	1913	Geared	Direct current	2,400
*Canadian Northern	1914	Geared	Direct current	2,400
*Canadian Pacific	1914	Geared	Direct current	2,400

It is a noteworthy fact that the use of the single-phase motor has not extended beyond the two original roads installing this type of equipment, the Grand Trunk and the New York, New Haven & Hartford (including the Hoosac Tunnel installation), whereas direct-current motors have been universally adopted in all the more recent electrifications with the single exception of the split-phase installation on the Norfolk & Western Railway.

The so-called "split-phase" system is comparatively a newcomer in the electric traction field, and it has not yet been subjected to the test of actual operation. It offers many attractive features, however, for heavy electric railway service. From experimental tests made, it seems reasonably certain that the split-phase locomotive can meet the demands of commercial operation with satisfactory reliability.

Confronted with the problem of main line electrification and the demand for a distributing system which would provide for the economical distribution of large units of power over an extended area, the Butte, Anaconda & Pacific Railway appreciated the need of higher direct-current voltage, and as a result made its first installation of 2,400 volts direct current, under which operation began on May 28, 1913. This installation marks an epoch in electric railway progress, as its success constitutes substantial proof that direct-current motor equipments can be constructed at a reasonable cost and operated in an efficient and reliable manner with trolley potentials as high as 2,400 volts. It has been characteristic of the installations operating at 1,200 and 1,500 volts that the reliability of the direct-current motive power has been in no way impaired by reason of using a higher trolley voltage; in fact, the maintenance cost of 1,200-volt motor equipments shows no increase over that of 600-volt equipments. A brush life of over 150,000 miles gives evidence of good commutator performance with practically no wear, and the increased insulation provided has been ample to insure reliability and low cost of maintenance. The transition from 1,200 volts to 2,400 volts direct current has also resulted in completely successful operation at this potential.

ELECTRIC LOCOMOTIVES.

Norfolk & Western split-phase locomotives.—One of the newest and latest departures is the equipment, by the Norfolk & Western Railway, of a mountain division for single-phase, or "split-phase," locomotive operation. The locomotives handle freight trains of 3,250 tons' weight, exclusive of the locomotive, at a speed of 14 miles per hour on a 2 per cent grade, and they will be operated at speeds up to 28 miles per hour on lighter grades. Four locomotives will be used on the heaviest grades, two in front and two at the rear of each train. They are arranged for multiple-unit operation in pairs, but no electrical connection will exist between the two ends of the train. The motors for these locomotives present a novel departure from existing practice in design for traction purposes. They are constructed without commutators, and follow the principles of the standard polyphase induction motor, retaining all the advantages in ruggedness and absence of complication which are characteristic of the latter type. As they utilize power which is originally in single-phase form as received from the overhead conductors, the current is passed through a phase-splitting device before reaching the motors, so that the equipment as a whole may be properly described as of the single-phase-polyphase type.

In detail, the electrical equipment of each locomotive comprises four polyphase induction motors of a total continuous rating of about 1,300 horsepower at 14 miles per hour. Each motor has windings for producing either four or eight poles so that the speed may be changed accordingly, and is equipped with a wound secondary in order to provide for the insertion of resistance and for connection in cascade for low speed at starting and for switching service. There are thus two running speeds, 28 and 14 miles per hour, and a switching speed of 7 miles per hour.

The motors are geared in pairs through jack shafts, cranks, and side rods to the driving wheels, the gear ratio being 85:18, and the driving wheels 62 inches in diameter. Each pair of motors is mounted on a truck with two driving axles and a pony axle, the latter carrying 30-inch wheels. The two trucks are coupled together by a Mallet hinge.

The trolley voltage is 11,000, and the frequency 25 cycles per second. Part of the trolley wire is fed direct from the 11,000-volt generator in the power house at Bluefield and part through transformers lowering the pressure from 33,000 volts, at which the outlying parts of the line are supplied. On each locomotive is a single transformer stepping the voltage down from 11,000 to approximately 750, provision being made for a slight adjustment of the secondary voltage. From this, secondary current passes through a rotating induction apparatus for transforming the phase relation, provision being made for suitable adjustment for keeping the phase voltages balanced.

The polyphase current then passes into the motors. These, as previously stated, have wound secondaries and slip rings arranged for cascade connection.

This type of induction motor, while quite unusual in the traction field, has been very successful in different forms in rolling-mill work and the like. It has several important advantages in this case. In the first place, the grades to be encountered are unusually heavy, and regenerative control will be a considerable advantage. This is true not so much on account of the saving in power as from the consideration of safety in descending grades. Incidentally, there will undoubtedly be a considerable saving in wear of brakeshoes and tires. In descending grades, the two units composing the head locomotive will be connected to pump their electrical energy back into the line and they will be loaded to their full capacity. When other trains are in the electric division, the saving will be considerable, as this method will lighten the load on the station and improve its load factor. When the descending train is the only one on the line, the power thus developed will be absorbed by rheostats in the power plant.

The locomotives are the first to be commercially used in this country with a combined jackshaft and gear drive. Four driving axles and two carrying axles are used, the wheel base being divided into two separate units or trucks, connected at adjacent ends by a hinge coupling. The carrying axles are mounted radially, and each main truck has two driving axles and one radial axle. The outer ends of the trucks are fitted with standard buffers and friction draft gear with standard couplers, the drawbar pull being transmitted through the truck frames to the train. The weight does not exceed 57,000 pounds per pair of drivers and is sufficient to produce a tractive adhesion for a maximum effort of 62,500 pounds per locomotive, the weight on each radial axle being not less than 20,000 pounds at the rails. The locomotive will, with forced ventilation, have sufficient capacity to exert continuously a tractive effort of 33,600 pounds.

A single cab supported on the trucks at suitable bearing points contains the operating and control apparatus of the locomotive. The cab is of the box form, provided with end doors and platforms for convenient passage between two or more locomotives when coupled together, and between the locomotive and train; in addition, side doors are provided at diagonally opposite corners. There are also side and end windows for lighting the cab. The apparatus is arranged along the center of the cab, making it conveniently accessible and leaving a clear, unobstructed passageway at either side.

The control apparatus, both air and electric, is located at one end of the cab, in such a manner as to leave an unobstructed view along the track. The operator's seat is placed so that there is a clear view of the signals.

The motors are connected through twin gearing to a jackshaft. They are of the polyphase, 25-cycle, induction type with wound secondaries, which are connected in cascade for producing low speed in starting and switching. There are, as noted, two running speeds, 28 and 14 miles per hour, and a switching speed of 7 miles per hour. In starting with the 7-mile combination, the motors on each truck are connected in cascade, and the two sets of cascades are connected in parallel. Resistance is inserted in the secondaries at starting. In this combination the primaries are arranged for eight poles. With the 14-mile combination all motors are in parallel, connected for eight poles; and with the 28-mile combination the four-pole arrangement is employed, resistance being used on intermediate steps.

A multiple-unit system of control is provided for the independent operation of each locomotive, or for the operation of two units simultaneously from the control end of either, in whatever order or arrangement they may be coupled together. The control equipment is arranged and constructed to provide for the use of single-phase current from the pantograph trolley, which is connected to the primary winding of the main transformer through a suitable line switch, while from the secondary of the transformer, circuits are established through and in connection with the phase converter in such a manner as to deliver polyphase current to the main motors.

Each locomotive is provided with an air compressor driven from the phase converter through a multiple-disk friction clutch. This clutch is controlled by the main reservoir pressure, so that the compressor is operated only as required. Straight-air and automatic air brakes are installed, together with the necessary ventilating apparatus for the motors.

The use of the induction motor in place of the commutator motor for this installation involves an important consideration, in addition to those mentioned, namely, that of cost. On account of the space limitations combined with the particular speed specified, the induction motor worked out cheaper than the commutator motor. The space limitations dictated a long motor, small in diameter, and although a commutator motor would have been entirely practicable it would have been more expensive than the induction motor at the low speed required. At a somewhat higher speed the condition might have been reversed. Hence a decision between the two types must be based, not upon their operating characteristics alone, but upon these combined with cost under space limitations.

The contract calls for the manufacture and delivery of 26 130-ton electric locomotives of the single-phase-polyphase type, together with all required power-house generating machinery and transmission apparatus. The use of the two running speeds of 14 miles per hour and 28 miles per hour, which will be to a large degree maintained very closely, will under the

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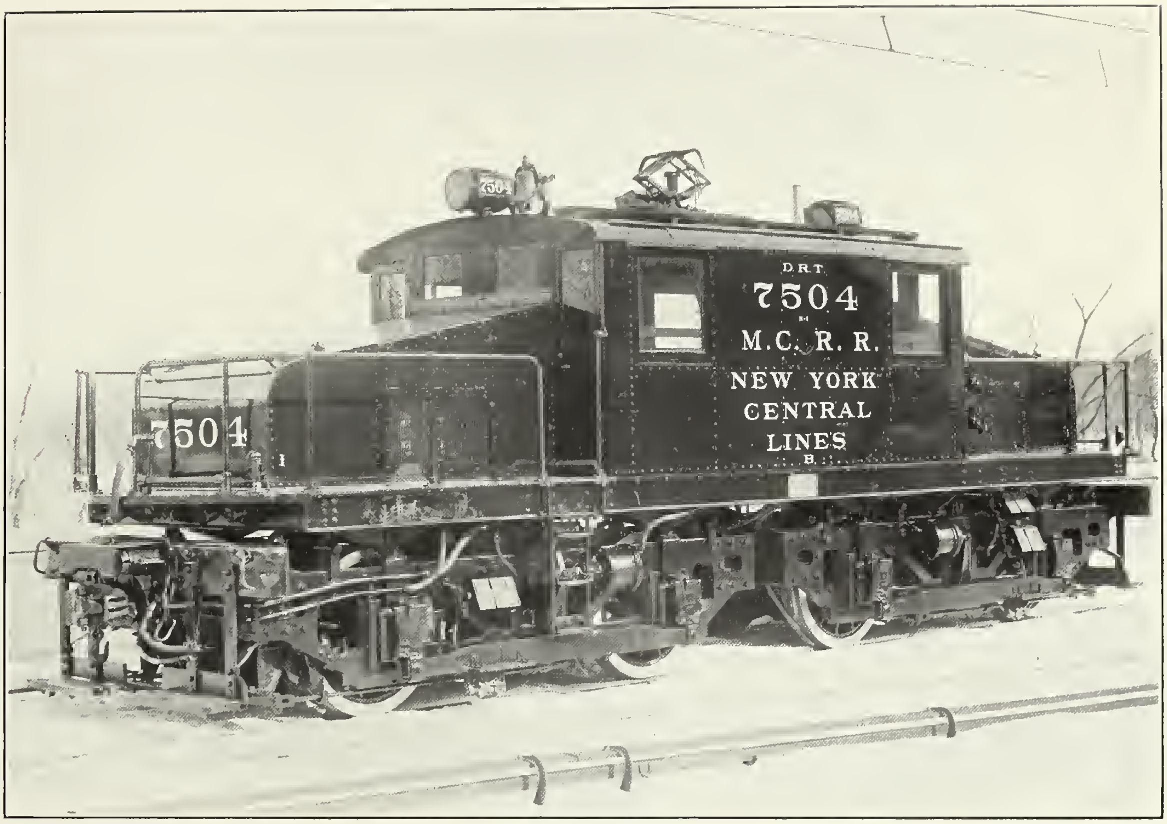
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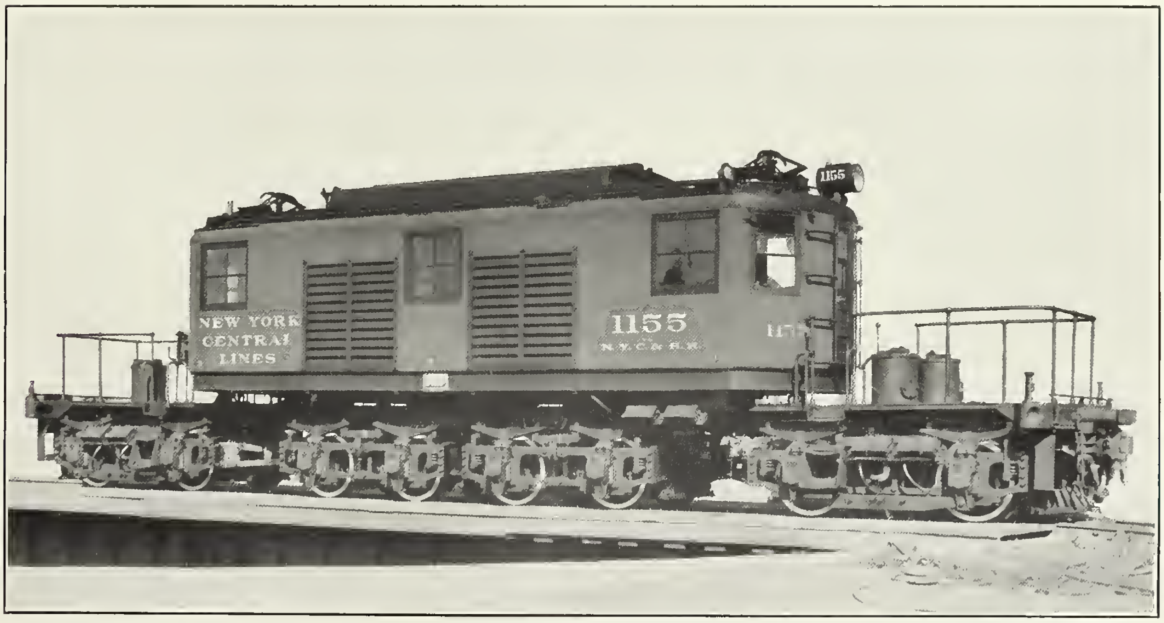
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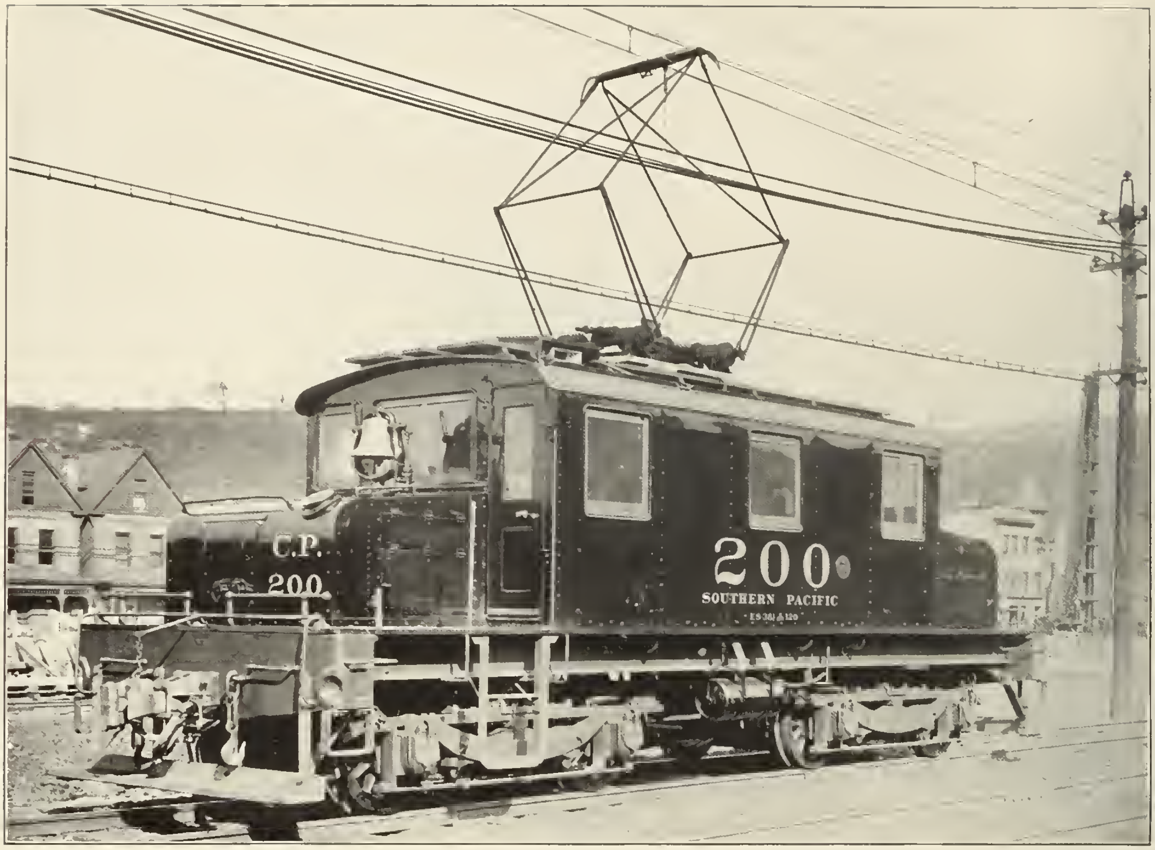
600-VOLT LOCOMOTIVE.

(Face p. 408.)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800–1200-VOLT D. C. LOCOMOTIVE; SOUTHERN PACIFIC RAILROAD CO.

2,400-VOLT LOCOMOTIVE; BUTTE, ANACONDA & PACIFIC RAILWAY CO.

circumstances existing in this case be particularly applicable for the service, as the locomotives are intended for handling only "tonnage trains." These are loaded with coal originating in the vicinity, as the Bluefield-Vivian division serves the celebrated Pocahontas coal region, one of the largest coal fields in the world. The shipments of coal handled amount to 65,000 tons per day, and the trains weigh as much as 3,250 tons; and it is to facilitate the handling of this heavy traffic that electrical operation has been adopted.

As mentioned before, there are a number of grades on this section, the maximum being 2 per cent, and three Mallet locomotives, the most powerful type of steam locomotives built, have been required for each train, one locomotive being used at the head of the train and two for pushing. With the electric system and the present steam speed will be doubled. The extent to which this quick train movement will enlarge the capacity of the railroad is quite apparent. In addition, one of the present impediments to rapid operation of this section of the road is the existence of a 3,100-foot tunnel which is difficult to ventilate. This tunnel under electric operation will, of course, owing to the absence of smoke and noxious gases, offer no impediment to frequent train movement.

Larger locomotives for New York Central.—The number of electric locomotives in use on the New York Central Railroad has steadily increased, 16 having been purchased in 1913. Those of the latest type are the largest, weighing 110 tons, with materially increased capacity for continuous service. The weight of trains hauled out of the Grand Central Terminal, New York City, is increasing steadily, and some of the more important trains now weigh over 1,000 tons. It has therefore been deemed desirable to have engines for the maximum service with very great continuous capacity, ample overload, and high momentary rating. The new locomotives are able to exert practically the same tractive effort continuously that the previous locomotives could exert for one hour. The 10-ton increase in weight in the new machines is accounted for mainly by the greater amount of material in the motors, which are of larger capacity. The speed and torque characteristics, however, have been kept practically the same, but capacity has been provided for hauling approximately 40 per cent greater tonnage in continuous service. The previous 100-ton locomotives have a capacity for developing 1,460 horsepower continuously and 2,000 horsepower for one hour, and can develop as high as 5,000 horsepower for short periods. This corresponds to a tractive effort of 9,000 pounds at 60 miles per hour continuously, or 13,500 pounds at 54 miles per hour at the one-hour rating. The newest engines develop 2,000 horsepower continuously, or 2,600 horsepower for one hour. The equivalent tractive effort is 14,000 pounds at 54 miles per hour continuously, or 20,000 pounds at 49 miles per hour at the one-hour rating. They are able to haul 1,100-ton trains in continuous service between the terminal and Harmon, on the Hudson River, and are capable of operating 1,200-ton trains on level tangent track continuously at 60 miles per hour in emergency service.

The new machines are of identically the same type as the ten 100-ton locomotives bought earlier in the year, having articulated frames with bogie guiding trucks at each end. The cab, containing the engineer's compartment and that for the operating mechanism, is swung between the two parts of the frame on center pins. Each section is carried on two-axle trucks having a driving motor mounted on each axle. All the axles are therefore driving axles, and the eight motors are of the standard bipolar gearless type.

The motors are provided with forced-air ventilation and are electrically connected permanently in parallel in pairs, the pairs being connected in three combinations, namely, series, series-parallel, and parallel. They are insulated for 1,200 volts, so that if at any future time it should be desired to operate the locomotive on this higher voltage the pairs of motors could be changed from parallel to series connections and the same speeds and control combinations obtained as on 600 volts. Compared with previous types these machines have exceptionally large capacity and high efficiency, but the total weight, weight per driving axle, and "dead weight" are exceedingly low.

New Haven switching locomotives.—Approximately 8,000,000 people are served directly by the New York, New Haven & Hartford Railroad. Of all freight hauled in and out of New England by rail, this road handles 75 per cent. The bulk of this freight handled at New York is carried via the Harlem River division and the Harlem River and Westchester freight and transfer yards. Although the electrification of the New Haven road between New York and New Haven is not yet complete, the switching of all freight cars between Stamford and the Harlem River has been done successfully by electricity since 1912. The economies obtained by the use of the electric switch locomotives have exceeded all the expectations of those who are responsible for their adoption, and their operation is a source of satisfaction to the operating department and trainmen who have this work in charge.[1]

The three main switching yards on the New Haven System are the Harlem River yard, with a length of 23.3 miles; the Oak Point yard, with a length of 37.16 miles; and the Westchester yard, with a length of 22.29 miles; also the Van Nest yards, which are used for storage only.

In March, 1911, the first switching engine was placed in operation at Stamford, Conn. In August, 1912, the first switcher started to work in the Westchester yards; in September, 1912, the first in the Oak Point yards began work in float-dock service; and in August, 1913, the first began its operation in the Harlem River yards proper.

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[1] Electric Traction, March, 1914.

The service performed by these locomotives in the Oak Point yard is of special interest. This is the terminal where all the cars on floats destined to the New England states are unloaded.

On account of the care required to keep a float from capsizing, it requires six movements to unload it and dispatch a train to the yard; also, six movements are necessary to load a float. The minimum time required to load and unload (12 movements) is 35 minutes. Six single-phase electric locomotives do the work of approximately twice the number of steam locomotives formerly used. A total of eight of these electric locomotives are sufficient for practically all of the switching work between Stamford and Harlem River Station. These are kept in service 24 hours a day, each making an average of approximately 140 miles in 24 hours with three 8-hour crew shifts. The six electric locomotives handling the work between Westchester yard and Harlem River during one month made 38,000 locomotive miles, consumed approximately 896,000 kilowatt hours of electrical energy at the locomotive, and handled approximately 65,000 cars which had a total weight estimated at approximately 1,000,000 tons. Practically all of these cars were transferred from floats. All of the heavy freight tonnage mentioned above is handled within the corporate limits of New York City, and the elimination of smoke by the use of the electric locomotive is another advantage which has a special interest to all residents in the vicinity.

There are 16 switching locomotives included in this installation. Each locomotive is equipped with four 125-horsepower, 25-cycle, single-phase motors with unit switch control. They weigh 80 tons and are able to exert a maximum tractive effort of 40,000 pounds with a clean, dry rail. The locomotives can exert a maximum tractive effort of 36,000 pounds for about three minutes at speeds up to 6 miles per hour, and a continuous tractive effort of 14,800 pounds at a speed of 11½ miles per hour. In practice it has been found that an electric switching locomotive can do the work of two steam locomotives because it can be operated both day and night. In fact, the first switching locomotive furnished has been in use for about 20 hours a day in the yards at Stamford. It is not expected that the maximum voltage on the motors will be reached in ordinary switching service, but it is available when climbing grades or on longer runs in the yards. The average operating potential is estimated to be 190 volts. The hour rating corresponding to this voltage, with current of 900 amperes, is approximately 125 horsepower per motor.

Arrangements have been made for a large bridge, known as the interconnecting railroad bridge, between Harlem River and Long Island City, which will physically connect the Pennsylvania and New Haven systems. Electricity as a motive power will be used entirely for handling all traffic over this bridge.

Piedmont & Northern 1,500-volt locomotives.—The Piedmont & Northern lines, Charlotte, N. C., are placing in commission six new 1,500-volt, direct-current, electric locomotives on the Greenville, Spartanburg & Anderson division of the system. These locomotives weigh 63½ tons, with all the weight on the drivers, have the box type of cab extending nearly the entire length of the underframe, and are designed for heavy freight service. At the normal rating of the four motors, with which each locomotive is equipped, operated on 1,500 volts, two in series, they can develop a tractive effort of 17,500 pounds and a speed of 21 miles per hour. The locomotives handle trains of 800 to 1,000 tons, gross weight.

The Piedmont & Northern lines comprise two main divisions, which, when entirely completed, will embrace 280 miles of track. All these lines operate on 1,500 volts direct current. Energy is purchased from the Southern Power Co., and is delivered from the transmission lines to two substations for the Piedmont Traction Co. On the southern division of the road there are four substations. The lines have a very heavy freight traffic and transport great quantities of cotton from shipping points to mills along the route, and, in turn, fabric from the mills to connecting stations for distribution to distant markets.

In these locomotives the cab is open as far as is consistent with the location of the apparatus therein. While this apparatus is grouped in the central section, it is not located in a compartment separate from the engineman's operating cabs. Convenient passageways run along the sides and connect with the operating position in each end. The underframe consists of four 10-inch steel channels extending the entire length of the platform. These channels are tied together by heavy end-frame box-girder castings and bolster plates, each channel being riveted to the webs of the end-frame castings and to the top and bottom bolster plates. The bolsters are built up of 18-inch by 1-inch plates, the top bolsters being carried clear across the platform and riveted to all four longitudinal sills. The two center channels are inclosed throughout with steel plates riveted to the sills and carrying the center castings, which are bolted to them. The space between the center sills serves as a reservoir for distributing air from the blowers to the motors. Openings in the floor of this reservoir admit air from it through suitable intake pipes to the backs of the motors.

The two four-wheel trucks of the swivel type are designed for heavy freight work, and conform to M. C. B. standards. The wheels are solid rolled steel, 36-inch diameter, and the axles have 5½-inch by 10-inch journals. The air brakes are the combined straight and automatic type.

The locomotive is driven by four 600/1,200-volt box-frame commutating-pole motors, insulated for operation at 1,500 volts. Each motor is geared to an axle. The gear ratio is 65 : 18, making the gear reduction 3.61. The continuous capacity of each motor is 200 amperes under forced ventilation, and the one-hour capacity is 269 amperes. For the complete equipment of four motors on a locomotive this is equivalent to a continuously sustained tractive effort of 11,200 pounds at the rail. The motor is inclosed and is designed especially for locomotive service. Through the method of forced ventilation employed, air is circulated over the armature and field coils, over and through the commutator, through longitudinal holes in the armature core, and thence exhausted through openings in the bearing head.

The multiple-unit control is arranged to operate the four motors in series and series-parallel connections. The transition between series and series-parallel is effected without opening the motor circuit, and there is no appreciable reduction in tractive effort during the change. This smooth transition between control points permits operating the motors close to the slipping point of the wheels throughout the entire range of acceleration without sudden fluctuations of tractive effort.

One of the distinctive features is the convenient manner in which the apparatus is arranged in the central section of the cab so as to afford ready access to all parts for inspection, cleaning, adjustment, or repair. The main motor rheostat boxes are mounted in banks in an inclosed sheet-steel compartment in the cab center. This compartment extends from the floor to the roof and is accessible through doors opening into the passageways on the sides. The floor in the compartment is open, and it is surmounted by an open monitor deck. Thus there is a continuous draft of air rushing up through the compartment while the locomotive is running, affording exceptionally good ventilation.

The blower set for ventilating the motors has a capacity of 2,000 cubic feet per minute, and is driven by a series-wound motor of the railway type. Air is taken from the exterior through a suction box with side louvers underneath the platform at the center. Current at 600 volts for the operation of the blower, the air compressors, the contactors, and the light is furnished from a tap taken from the dynamotor.

Current is collected by an overhead pantograph trolley pneumatically controlled. On some of the ocal lines which form the system the overhead construction is not adapted for the pantograph trolley, and in order to operate over such lines the locomotives are equipped also with pole-type trolleys and trolley wheels. Some of these local lines are operated on 600 volts, and in some cases as low as 500 volts, direct current. A change-over switch is installed for cutting out the dynamotor while the locomotive is operating on low-voltage circuits, so that in such cases the current for the auxiliary control and supply circuits is obtained direct from the trolley circuit. This change-over switch is protected by an automatic relay, which makes it impossible to connect the 1,500-volt trolley current to the auxiliary circuits of the locomotive.

Results in electric locomotive operation.—With regard to results obtained under electrification, Mr. E. B. Katte, chief engineer for electric traction, New York Central Railroad, stated at the meeting of the New York Railroad Club, March 20, 1913, that at that time the Hudson division was operating 56 trains a day, equivalent to 7,000 multiple-unit car-miles, and the Harlem division was operating 72 trains a day, equivalent to 7,800 multiple-unit car-miles. The average number of trains which operated in and out of the Grand Central Terminal was 525 a day. A new record for reliability had been made as compared with preceding years, namely, the electric locomotives had operated 4,709 miles and the multiple-unit suburban cars 10,798 miles for each minute of detention due to electrical causes. Likewise, the multiple-unit cars had operated 12,374 miles per minute of detention due to mechanical causes. The average number of miles of operation per minute of detention on the whole electrical division due to all electrical and mechanical causes, including line trouble, etc., was 4,861 in 1912, 1,200 in 1911, and 1,785 in 1910. A table, which classified all detention troubles and mileages for every month of 1912, showed that the company operated 1,351,577 locomotive-miles and 4,297,633 multiple-unit-miles. The electric locomotives and multiple-unit cars had been in operation for more than six years. During 1912 the maintenance and renewal cost of the locomotives, including shop expenses, painting, etc., was 3.34 cents per mile, compared with 3.2 cents in 1910 and 3.08 cents in 1911, making the general average, say, 3.33 cents. Similarly, the maintenance and renewal cost of the multiple-unit cars was 1.8 cents per car-mile in 1912, 2.1 cents in 1911, and 1.9 cents in 1910, but Mr. Katte estimated that the average cost would run about 2 cents per car-mile.

GENERAL FEATURES OF RAILWAY MOTOR IMPROVEMENT.

It is, of course, extremely difficult to enumerate and sum up all the improvements which, step by step, have brought the electric railway motor up to its present condition of efficiency and durability, but an excellent summary has been made by Mr. W. N. Storer. The evolution of the modern railway motor began in the early eighties and is practically all confined to a period of 30 years, which may be divided into about five stages, as follows: First, the period embracing the experiments of the early inventors, such as Field, Henry, Daft, Edison, Van Depoele, Farmer, Bentley, Knight, Short, and Sprague; second, the period covering the exploitation of the double-reduction motor between the years 1886 and 1891; third, the period from 1891 to 1907, covering the development of the single-reduction motor of the straight-series type; fourth, the period from 1907 to 1911, covering the development of the commutating-pole motor; fifth, the period beginning in 1911, not yet completed, covering the era of economy in operation.

The motors at the end of the third stage may be said to have had embodied in them practically all of the improvements which had been developed prior to that time, and the following features are now common to all railway motors: Inclosed type with cast-steel frames; four laminated radial pole pieces bolted into the frame; mummified strap-wound field coils insulated with asbestos paper between adjacent turns, the entire coil impregnated in a vacuum; large armature shafts carried in bearing housings extending inside of the armature at the pinion end and inside the commutator at the front end; bearings well lubricated by the use of oil-soaked waste; separate oil wells for gauging the depth of oil and for receiving fresh oil; efficient oil throwers as a preventive of the oil reaching the interior of the motor; spring packing of field coils to counteract the effect of shrinking insulation, and thus prevent loosening; improved methods of holding motor leads to prevent vibration and breaking; two-point suspension of gear cases; commutator cover with simple and reliable cam-locking device; slotted drum-wound armature; ventilated armature; form-wound armature coils assembled in sets of three coils each; armature core and commutator assembled on the spider; armature bands laid in grooves in the armature coil; coils protected by asbestos hoods on the commutator end; high-grade insulation commutators with mica extending beyond the copper, both on the inside of the commutator and at the end next to the windings, to prevent short circuits; improved brush holders with high-grade insulating tubes protected by brass shells where clamped and by porcelain sleeves to give creepage surface; brush holders with adjustable tension and frictionless springs; high-grade carbon brushes; and many other small details which contribute to the success of the motor but can scarcely be enumerated.

The inclosed type of motor resulted from the large amount of trouble experienced from mud and water splashing into the early types and causing their insulation to break down. The use of the four radial poles followed the attempt to get the most compact as well as the lightest design for street-car motors.

Laminated pole pieces were introduced to decrease the loss from eddy currents in the pole faces, which, with the high inductions introduced with the slotted armature and small air gaps, increased greatly the total loss in the motor. Later the generator practice of saturating the pole tips by cutting off alternate pole tips from the punchings was introduced.

The use of mummified strap-wound field coils with asbestos insulation has become practically universal, and the use of round wire is permitted only on the smallest sizes of motors, where no gain is secured by the use of the flat copper ribbon. This type of field coil has been a wonderful improvement over the earlier types. With heat-proof insulation in the interior of the coil, it is able to withstand a much higher temperature, and the external insulation, which is completely filled with varnish, etc., makes it practically waterproof as well. Some motors had field coils of copper ribbon insulated with asbestos between turns. They were, however, wound in metal bobbin shells or spools and could not be wound tight enough to prevent the chafing of insulation and grounding. The mummified construction eliminated this trouble and has made a solid coil which, when used with the spring packing, is held perfectly tight. The use of springs back of the field coils to insure their being held firmly at all times has been a great improvement in the motors. It prevents the breaking of leads and chafing of insulation, which would result in grounded field coils.

Probably no improvement has been more marked or has done more to keep the motor cars out of the repair shop than the introduction of the standard type of bearing housing and method of lubrication. With the old grease lubrication it was no uncommon thing for armature bearing shells to be replaced after 3,000 miles of service. The life of the bearing on the motor may now be almost anything up to 300,000 or 400,000 miles. This extraordinary result is due to the excellent design of the bearing, which has the waste packed against the shaft on the low-pressure side, with the pressure of a column of waste over it, the oil being fed from below, coming from the well, which may be gauged at any time to see that the oil is kept at the proper level. This type of bearing has been universally adopted. It is scarcely necessary to add oil to the bearings more than once a month, so that not only is the cost of lubrication reduced to a negligible quantity, but the cost of maintaining the bearings and the loss due to the armature getting down on the pole pieces, which was a fruitful source of expense with the old bearings, have been practically eliminated.

The modern armature is a very different piece of apparatus from that of 20 or 25 years ago. Then either the armatures were hand wound or the coils were wound on a form and driven down on the ends of the armature with a mallet in the process of winding them. The evolution from that type to the one used at present has been gradual. Some early motors had only one armature coil per slot; others had two coils per slot or three coils per slot. A later motor introduced the barrel-shaped armature winding with the ends left open to provide circulation of air through the coils, and another had form-wound coils with sloping ends bound firmly on them. The modern type has the coils projecting straight out, banded to the coil support, and completely covered with canvas or asbestos cloth caps. The asbestos hoods on the front ends of the armature windings were introduced to prevent the damage incident to flashing, which may occur from any cause and is liable to set fire to a canvas covering.

The modern brush holders are a great improvement over the earlier form not only in accuracy of adjustment but in simplicity of insulation, substantialness of design, and the use of adjustable frictionless springs. Sluggish brush holders and inaccurate adjustments used to be fruitful sources of bad commutation and flashing, but have been almost entirely eliminated.

Another improvement introduced was the use of longitudinal holes through the armature core, that served the double purpose of providing paths for circulation of air and of "saturating" the iron beneath the armature slots, with thereby improved commutation. The saturation has been largely abandoned on later motors, but the air ducts are continued.

Another improvement for small motors is the armature spider, which carries not only the armature core but the commutator and thus permits the easiest possible renewal of bent or broken armature shafts. It also stiffens up the shaft in the spider, gives a much larger diameter for carrying the armature punchings, and holds them tighter. There is less possibility of relative motion between the armature core and the commutator, as both are keyed to comparatively large diameters on the same spider.

Coming at a time when the straight-series motor had thus reached a high state of perfection, the commutating-pole motor introduced in 1907–8 was an immediate and unqualified success. It had the benefit of all of the experience gained in the design and operation of the earlier motors and, added to that, the use of the commutating pole, which eliminated the last serious objection to the direct-current street-car motor, namely, the troubles incident to the commutation of the current. However, the commutating pole was not the only new feature. Intensive study of the subject led to still further minor improvements in the motors, and some very valuable features were introduced. Among them was the two-turn strap-wound coil, which was a triumph in the art of armature winding. The method of forming the coils used in this motor obviates all of the difficulties which had previously been experienced with that type of coil. It gives increased efficiency, larger capacity, better insulation, and more substantial construction than the ordinary wire winding.

The high-grade carbon brushes which came into extensive use about the same time, the undercutting of the mica on the commutator surface, and the sparkless commutation due to the commutating pole have practically eliminated wear on the commutator and greatly increased the life of the brushes. The amount of carbon and copper dust originating in the motor, which would tend to reduce the efficiency of the insulating surfaces, is therefore very small. This feature is of the utmost importance in the motor to be used on high-voltage circuits and greatly increases its reliability. Without it the high-voltage motor would have been a difficult, if not a commercially impossible, problem. With it the modern motor operates better on 1,500-volt circuits than the old motor did on 600 volts.

Mr. Storer discusses other elements of improvement, notably those involved in the attempt to reduce the weight, and holds that in general it is dangerous to make radical reductions in the weight of railway motors. The motors built 10 years ago were lighter in weight than the standard motors of to-day, but they were not nearly so reliable. For instance, a reduction in the size of armature shafts, which have been brought to their present generous proportions by years of hard experience, even though accompanied by the use of heat-treated material, is dangerous. Heat-treated materials have not yet reached the stage where they can be considered as standard, and until the methods of heat treating steel are much better understood by the general run of manufacturers and it is possible to obtain more uniform results by such treatment, it is better to make shafts strong enough to stand the service required of them without a resort to heat treatment.

The use of a coasting-time clock and of similar devices has drawn attention to the tremendous waste of power due to inefficient handling of equipment. It is said that the coasting-time clock, by putting a premium on rapid acceleration and on the maximum amount of coasting, has resulted in a saving of power consumption in some places of 20 per cent to 25 per cent, or even more. Efficient handling of the cars may in some cases result in so much less heating in the motors as to permit the use of a smaller size of motor, which will thus effect a reduction in weight without a decrease in mechanical strength.

Another method for reducing the weight of the equipment is the use of ventilated motors. For some years past the use of forced ventilation has been common on locomotive motors, and some motors for street-car service as well. The motors on the Long Isand Railroad have, for example, been operated for several years with forced ventilation secured by the use of small motor-driven blowers. The circulation of the external air through the internal parts of the motor is very effective in carrying off heat and increases very largely the continuous capacity of the motor. The same result may be brought about by the use of perforated covers on the motor or of a fan on the armature shaft arranged so as to draw air through all parts of the motor. Either method is very effective and is quite satisfactory where the dust and dirt do not offer a serious obstacle.

Undoubtedly the most positive power saver which has been introduced with the interpole motors in the last two years is field control. This, as is well known, is simply a revival of the old control system, used in some of the earliest railway motors. The early double-reduction motor made the most extensive use of this, since the control was entirely by commutating the field, and employed no external resistance at all. It was used to a greater or less degree in these motors and in one or two of the single-reduction motors as well. However, the commutation with slotted armatures was not good enough, and the points involved in the selection of equipments and the operation of motors were not well enough understood at that time to make the system a success. It was dropped nearly 20 years ago and was not revived to any great extent until it was applied on the locomotives of the New York, New Haven & Hartford Railroad in 1906 and 1907. These had single-phase motors of the series-compensated type, which permitted a wide range of variation in the field strength without impairment of the commutation. The system in this instance worked with marked success. Its later application to the commutating-pole motors on the giant Pennsylvania locomotives used for the New York terminal was also an entire success, so that the engineers of the company which had furnished both of these types of locomotives were satisfied that this system of control could be used safely with any size of motor. The trial equipment placed in service on the Metropolitan Street Railway in New York City nearly two years ago met with just as great success as that of the locomotives, and the decrease in the energy consumption of this car equipment as compared with the standard type of equipment in use was quite remarkable. A motor of very slow speed was used, and the resistance was normally cut out of circuit before the car reached a speed of 8 miles per hour. Higher speeds were obtained by weakening the fields of the motors. The maximum speed obtained was hardly as high as that of the standard equipment, so that a part of the saving of power resulted from the lower speed, but the larger part of it was undoubtedly due to the use of field control.

PASSENGER TRAFFIC AND FARES.

The subject of fares is obviously one of vital importance to every street and electric railway, as upon the income derived from transportation depend the welfare and prosperity of the line, the ability to give good service, the proper upkeep of the system in all its physical details, the payment of wages acceptable to the employees, the increase of facilities for the public, and the introduction of improvements. Even if some of these requirements and other financial necessities are met out of new capital, it is not possible to enlist that capital unless it can be shown that the existing investment enjoys a fair return; so that it all comes back to rates and fares. In practically all instances the fares now in existence are fixed by franchise, by agreement with the municipality, or by valuation of the property, but the elements and bases, in fact the very principles, referred to in determining rates and fares, remain a subject of constant discussion and experiment. Various aspects of the problem are presented in the reports made at Chicago in October, 1912, to the American Electric Railway Association by the committee on determining the proper basis of rates and fares, which reached at least one definite conclusion, as follows: "In a business such as that of electric railways where approximately 33⅓ per cent to 40 per cent of the traffic is handled within 3 to 5 hours out of the 24, this representing practically the lowest load factor of any public utility, and where the cost of living and consequent wages paid are increasing by leaps and bounds, it is essential that the present 5-cent fare be limited in distance, and for the street railways of $5,000,000 annual gross earnings and less it is apparent that the length of ride should not be over 4 miles."

A separate report by a member of the committee, Mr. Henry G. Bradlee, presented data as to the conditions under which roads could be operated with reasonable profit and return on the investment, assuming 3 per cent for all wear and tear, 1½ per cent for taxes, and an average of 8 per cent on the securities, making 12½ per cent net that must be earned to provide for obsolescence and depreciation, pay taxes, and attract capital to an industry in which the investment needed doubles on the average once in seven years, in order that towns and cities may be adequately served. The data available, however, would indicate that there are very few street railways in the country paying 8 per cent dividends and setting aside 3 per cent for depreciation, etc., as they do not earn it under present conditions. The table based on actual conditions as reported and analyzed by Mr. Bradlee is given herewith. From the reports made it appeared that only in the larger cities could 25 5-cent-fare passengers per half trip be counted upon. This would make the maximum receipts per half trip $1.25, which would be the limiting factor in determining the distance over which the car could be profitably operated. It would appear from the table that even in the larger cities a distance of from 3½ to 4 miles for a 5-cent fare is the maximum length of trip per passenger for profitable operation. As a matter of fact, there are a considerable number of large cities where the length of ride would average over this.

Table Showing Investment, Operating Expenses, etc., for 20 Selected Electric Railways.

COMPANY.	Dollars investment per dollar of gross receipts.	Operating expenses per car-mile (cents).	Number of passengers per half round trip (5-cent fare).	Maximum length half trips for profitable operation (miles).
Annual gross receipts more than $1,000,000:				
A	$3.15	14.96	22.40	4.54
B	3.25	18.33	22.80	3.69
C	4.40	18.50	25.40	3.09
D	4.00	19.60	24.40	3.11
E	3.30	16.30	17.00	3.06
F	3.90	19.00	15.60	2.10
G	5.55	19.90	22.20	1.71
H	3.03	14.22	17.50	3.82
I	4.97	15.00	27.00	3.40
Annual gross receipts more than $750,000 and less than $1,000,000:				
A	3.00	18.40	13.20	2.24
Annual gross receipts more than $500,000 and less than $750,000:				
A	3.90	18.30	14.40	2.02
B	3.00	12.60	13.00	3.22
Annual gross receipts more than $250,000 and less than $500,000:				
A	3.80	18.60	15.30	2.16
B	4.40	12.00	13.40	2.51
C	4.20	13.70	8.70	1.51
D	4.40	13.70	7.40	1.21
Annual gross receipts less than $250,000:				
A	3.70	17.70	19.00	2.88
B	4.50	15.20	17.00	2.44
C	3.70	14.80	12.60	2.28
D	4.20	12.70	6.60	1.23

Mr. Bradlee stated that the figures derived would indicate quite clearly that urban street railway lines exceeding 4 miles in length must be a burden to the company rather than a source of profit, if operated for a 5-cent fare, and that an additional charge should be made on all lengths of haul exceeding 4 miles if the roads would earn a sufficient return to meet the higher expenses of operation and attract the new capital required for the extension of the industry.

Mr. Frank R. Ford, another member of this committee, filed a valuable memorandum as to existing rates and fares within the metropolitan areas of New York, Chicago, Boston, and Philadelphia. It summed up the general conditions existing at the end of 1912 in these four great cities. The metropolitan area of each of these cities has been assumed as that embraced within a circle of 16 miles radius, the center of which is located at the city hall, thus including 804 square miles, or 514,820 acres.

The United States census of 1910 showed a population for these metropolitan areas of approximately the following:

New York	6,198,440
Chicago	2,339,090
Philadelphia	1,940,833
Boston	1,572,079
Total of four cities	12,050,442

The magnitude of the electric railway interests of these four metropolitan cities is apparent when it is realized that they serve approximately one-third of the total population of urban localities of 8,000 inhabitants or more in the United States, represent a capitalization of approximately $1,250,000,000, and have gross revenues of over $200,000,000, equivalent to one-third of those of all the electric railways of the United States.

The urban and suburban passenger traffic of these cities is transported almost entirely by three systems: (*a*) Surface electric railways, (*b*) rapid transit systems of subway or elevated railroads, (*c*) steam railroads (in some cases electrified).

In New York City the rapid transit systems of elevated and subway lines carry a larger proportion of urban passengers than in any other American city, the number of such passengers carried by these systems in Greater New York in 1910 being 768,122,000, as compared with 763,140,000 on the electric surface lines, or about 50 per cent of the total. In Philadelphia, where the proportion of subway and elevated railroad mileage is the smallest for these four cities, approximately 8 per cent of the electric railway passengers in 1910 traveled on the subway and elevated line and 92 per cent on the surface railways.

The proportionate passenger traffic handled by the steam railroads is small as compared with that of the electric railways. In Philadelphia, for instance, where steam suburban railroads are noted as being among the best in American cities and where other rapid-transit facilities are limited, the total number of passengers carried in one day in 1910 was equal to less than 6 per cent of the number carried by the local electric railway system.

New York fare limits of electric surface lines.—In metropolitan New York the surface electric lines are divided geographically by the rivers into one principal system for Brooklyn, two for Manhattan and The Bronx, and one for New Jersey, with a few smaller independent companies on the outskirts. The rates of fare have been determined largely by the original franchises, which were based on early political boundaries. The 5-cent rate of fare for Manhattan Borough gives a maximum ride of 13.41 miles from the city hall to the northern limit. Similarly, the 5-cent rate from the Manhattan side of the East River bridges carries to practically any part of the built-up district of Brooklyn and Queens.

In the Borough of The Bronx, the next 5-cent zone, making a 10-cent limit from the city hall, extends beyond the 16-mile circle, and this is also the case for the central part of Long Island, although on its north and south shores the limits of the circle run from 15 cents to 20 cents from the city hall. In Staten Island (Richmond Borough) and in New Jersey, because of the disconnected locations of the various communities, the 16-mile circle practically coincides with the 20-cent limit if 5 cents for the Hudson River tunnel fare be included.

Thus the maximum ride to the edge of the metropolitan district varies from 0.6 cent per mile in Greater New York to 1¼ cents in New Jersey. In other words, to the north and east of the city hall, where the traffic is densest and the municipal boundaries are most extended, the rate per mile is approximately one-half the rate to the west and south.

Chicago fares.—In Chicago the traction settlement of 1907 imposed a 5-cent fare to the city limits on lines of the two large street railway systems. This limit is approximately 10 miles to the south, west, and north of the business center, giving a maximum ride at approximately one-half cent per mile. Beyond this limit the next 5-cent zone or 10-cent limit from the city hall carries a passenger from 3 to 5 miles farther. The 15-cent limit approximately coincides with the 16-mile circle, giving a maximum ride at about 1 cent per mile, this, however, representing an average of 2 cents per mile for the two outside zones as compared with one-half cent for the inner zone. The electric lines outside of the inner 5-cent fare limit in some cases are operated in connection with the city surface railways, and in others with the city elevated system.

Philadelphia fares.—In Philadelphia practically all of the street railways within the city limits are operated by one company at the 5-cent rate, and the same is true with respect to the adjacent portion of New Jersey. The 5-cent zone extends approximately 5 miles to the west of the city hall and 10 miles to the north, giving a maximum ride from the center at the rate of 1 cent per mile westwardly and one-half cent northwardly. Outside of the 5-cent limit, with few exceptions, the suburban trolley systems are independent. The second 5-cent zone, making a 10-cent fare limit from the city hall, extends from 8 to 11 miles from the center on the west, from 12 to 14 miles on the north, and in New Jersey (exclusive of ferry fare) from 6 to 8 miles out. The 15-cent fare limit on the west extends from 10 to 13 miles from the city hall, and on the north practically coincides with the 16-mile circle, while in New Jersey it extends from 8 to 14 miles from the center. The 20-cent limit on the west varies from 13 to 16 miles, and in New Jersey extends from 10 miles out to the 16-mile circle, although in places this circle overlaps the 25-cent limit both to the west and in New Jersey. Consequently, maximum fares within the 16-mile circle vary from 15 to 25 cents, or approximately from 1 to 1½ cents per mile.

Boston fares.—The electric transportation system of Boston has been developed along somewhat different lines from those followed in the other cities, in that the subway and elevated lines are operated jointly with and as an integral part of the surface system. The rapid-transit lines transport by wholesale passengers from the center of the city to transfer distribution points in the near-by suburbs. There free transfer is made to the surface lines in terminal stations without the use of tickets. It is consequently impracticable for statistical purposes to separate the rapid-transit and surface systems of Boston. The electric transportation business is principally conducted by two systems, one in the central portion of the metropolitan area, the other in the suburbs. There are also one other considerable suburban system and two interurban lines.

The 5-cent fare limit extends about 5 to 9 miles from the center of the city, giving an average rate of 0.7 cent per mile for these maximum distances. The 10-cent limit extends from about 8½ to nearly 14 miles from the center, producing an average rate of about 0.9 cent per mile for these total distances. The 15-cent limit extends from about 13 to 16 miles from the center, producing an average rate of about 1 cent per mile for the total distance.

The 10-cent limit of the electric roads practically marks the limit of the daily travel, which corresponds with the commutation travel of the steam roads. Beyond this 10-cent limit, nearly all of the regular traffic is handled by the steam railroads. This limitation of the area of electric travel is due to the lack of a real rapid-transit system extending any great distance from the center of the city, the time taken by the surface cars being too great to attract the regular traffic.

In all four cities the central business and residential districts constitute a zone of 5-cent cash fares. Transfers are practically universal, although in Philadelphia 3 cents is charged for exchange tickets (a form of transfer), and in Boston the same charge is made for transfer to the lines of an independent system. Upon some of the suburban lines around Boston a 6 cent fare is charged.

Fare limits of elevated and subway lines.—In these metropolitan cities, upon the street surfaces of the business districts becoming overcrowded, and with the extension of the residential areas, rapid-transit lines of elevated or subway railroads have been established, these usually being comprised within the limits of the central 5-cent fare zone of the surface railways.

In New York City the 5-cent fare limit of the elevated and subway system of Manhattan and The Bronx, under municipal ownership and private operation, has been extended to the north for a space of approximately 4 miles beyond the 5-cent limit of the surface system. This system has also been extended into Brooklyn so as to form a 5-cent fare limit encroaching upon the 5-cent fare zone of the Brooklyn surface system. The rapid-transit lines in Brooklyn, under the same ownership as the Brooklyn surface system, have approximately the same 5-cent fare limits and charge a second 5-cent fare to Coney Island.

To the north the rapid-transit limit gives a ride of about 14 miles from the center, or slightly more than one-third cent per mile, while in Brooklyn the 5-cent rapid-transit limit extends about 8 miles, giving a rate for the maximum ride of about 0.6 cent per mile.

To the west the Hudson Tunnel System charges a 6-cent rate for a distance of about 3 miles, equivalent to about 2 cents per mile. As extended to Newark, the fare on this line is 17 cents for about 9 miles, or approximately 2 cents per mile. This is probably the highest rate of fare charged by any rapid-transit system in these metropolitan areas, although it is stated that the total net income barely covers the interest upon its bonds, representing the large investment caused by its expensive submarine-tunnel construction. Another interesting feature of this operation is that for the entire distance above ground, in New Jersey, this line runs its cars over the main-line tracks of the Pennsylvania Railroad. The 60-trip monthly commutation charge to Newark is at the average rate of 1.06 cents per mile.

In Chicago upon the rapid-transit elevated system the 5-cent rate obtains to the terminals of all lines, or to the city limits. This 5-cent rate on the south extends for a distance of about 8 miles, and on the west and north for about 9 miles, giving an average rate for the maximum distance of about 0.6 cent per mile. Where this rapid-transit line extends beyond the city limits to the north, the 10-cent fare limit extends about 13 miles from the center, making the cost of the maximum ride about three-fourths cent per mile. To the west an interurban electric line connects with the elevated line, charging three 5-cent fares for the 6 miles to the 16-mile circle, approximately $2\frac{1}{2}$ cents per mile.

In Philadelphia the rapid-transit system comprises only $7\frac{1}{2}$ miles of a subway and elevated line running east and west and extending approximately 5 miles westwardly from the center, so that the maximum ride from the center is at the rate of about 1 cent per mile.

In Boston the rapid-transit and surface systems are operated jointly. Radiating from the center is a combined elevated and subway line extending to the north about $2\frac{1}{2}$ miles to Charlestown and about 5 miles to Forest Hills on the south. There is also a combined tunnel and bridge line to Cambridge.

Conditions of passenger traffic.—The report of the committee on passenger traffic at the 1913 convention of the American Electric Railway Association reveals a number of aspects of the problem not usually considered in a discussion of rates and fares. Such a question, for instance, is that of varying the hours of factory closing so as to prevent the congestion of traffic due to the closing of all the factories at the same hour, with a resultant enormous "peak" load. In Rochester, N. Y., it is stated that the various manufacturing companies are cooperating with the railway company with the best results to both. In Kansas City, Mo., the largest industries are stockyards and packing houses, employing about 35,000 persons, and in this case the rush-hour problem and peak load are somewhat lessened by the fact that these are served by from three to six lines, on which extra cars are put in operation at closing hours. The lines conducted a trial, however, with Montgomery, Ward & Co., employing from 2,000 to 2,500 people, in furnishing cars for employees of that company at the various hours of closing. The company agreed to make the hours of closing 5.50, 5.55, and 6 p. m., dividing the force into three practically equal parts. Later the time was changed to 5.10, 5.15, and 5.20 p. m. Extra service was placed on the lines by the railway company to meet these conditions, and the result was most pleasing to the employees and managements of the companies concerned. In answer to the question whether such a plan was feasible or possible, the majority of the companies replied that it was not, and especially as applied to their local conditions. This feeling was stronger among the interurban and smaller companies than with the companies serving populations of 100,000 or more, quite a number of which thought such a plan would be of benefit, although no efforts had been made in that direction.

The recommendation of the committee in regard to another important point was that passengers should be permitted to ride in the front vestibules of closed cars. The main objection to such a rule is found to be the risk of accident due to distraction of the motorman's attention. This risk has been greatly minimized by the use of steel cars, stronger underframing and body structure, and "anticlimbers," and by the standardization of types and heights of platforms. In connection with this question should be mentioned the difficulty of enforcing at all times the order prohibiting riding on the front platform. In 1909 the Pennsylvania state railroad commission drafted a rule against permitting passengers to ride on the front platforms of cars. In the early part of 1910 the Philadelphia Rapid Transit Co. stated that during the afternoon rush hour it was impossible to enforce the order without employment of physical force, and that it would require the assistance of the police to remove passengers in this manner. In September, 1912, the Chicago City Railway issued a folder stating that on near-side cars passengers were not permitted to remain upon the platform, but from investigations it was found that this rule could not be or is not adhered to during the rush-hour travel, platforms being filled to capacity at such times.

On the other hand, many companies are realizing the value of this space for passengers, as well as the use of passengers as witnesses to accidents. During 1910 the prepayment cars of the Metropolitan Street Railway Co., New York, and the Third Avenue Railroad were provided with folding seats on platforms in order to secure as much seating capacity as possible. The latest Pittsburgh cars at that time had no front platforms. The new near-side cars in use in Chicago, Buffalo, and Philadelphia would tend to show that the ancient prejudice against having passengers on the front platform is being overcome. This is also true of the type of cars now being placed in use on the New York Railways, Pittsburgh Railways, Brooklyn Rapid Transit, and United Railroads of San Francisco, of the vestibuleless type in Kansas City, where the seating capacity has been increased 10 per cent, and of cars in use by various other companies.

The following figures are given by the claim department of a large urban system in regard to the number of passengers injured while riding in front vestibules of cars in collision accidents during the months of October, November, and December, 1912:

MONTH.	Number of collisions.	Passengers injured.
Total	90	5
October	26	3
November	32	2
December	32	0

This same company reported that a very large percentage of the witness statements of passengers in front vestibules are favorable to the company, and that the information obtained therefrom is most valuable.

It is found that the question of free transportation is governed quite largely either by franchises or by state laws, and these have recognized to a large extent local conditions in cities and in states. Information was requested from 217 companies and replies received from nearly all. Of the total number, 177 companies issue transportation to all employees and 38 companies issue transportation to a portion of their employees. Free transportation issued by the larger companies is limited in a majority of cases to trainmen, officers, and operating officials. It appears to be the general policy of the smaller companies to issue transportation in some form to all employees, and to be the general practice to allow the use of a badge or uniform for the transportation of trainmen. Other employees are furnished with tickets, card passes, coupon books, or limited-trip books.

In regard to transportation furnished employees' families, 104 companies reported that they supplied transportation to families of certain employees, while 106 companies reported that they did not issue such transportation. A large percentage of the companies replying in the affirmative are interurban. Out of 30 of the largest companies from which information was received, 25 do not issue transportation to employees' families; 4 issue transportation to employees' families; and 1 company reported issuing transportation to employees' families on interurban lines and no transportation to employees' families on city lines. The general form of this transportation is in trip passes or a limited number of coupons, and in a number of cases such transportation is issued only on request.

Out of 217 companies making replies to the question as to free transportation to outside persons, 60 companies issue transportation to police, 48 to firemen, 45 to public officials, 28 to employees of other roads, 20 to charity, 17 to the press, 8 to mail carriers, and 14 to miscellaneous recipients, and 18 companies issue no free transportation to nonemployees. A decided tendency is noted toward discontinuance of all such free transportation. It seems to be the general custom to allow free transportation of police and firemen, either in full uniform or upon presentation of badge.

In the majority of cases a reduction on the round-trip fare is allowed on electric railways. Several years ago the steam roads allowed apparently the same reduction as is now given by most electric lines. The steam roads have, however, recognized the necessity for increased rates of fare, and as the revocation of this reduction furnished one of the easiest means of increasing their earnings, such action was taken; and it has been proved, so far as they are concerned, that it is not necessary to make this reduction in order to stimulate traffic.

It has been found that the one great objection to doing away with this reduction is that without it there would not be any inducement to purchase tickets and, as a result, an additional temptation would be placed in the way of the conductor on account of a greater amount of cash passing through his hands. This is no doubt true, but it has been proved in several cases that a dishonest conductor can manipulate tickets almost as easily as by the straight "knockdown" of cash.

There seemed to be a general movement on foot among the various member companies to do away with the reduction on round-trip fares. There have been several changes of this kind made within the past few years, and it is reported by these companies that a very material increase in earnings has been shown, the argument being put forth by them that in consideration of the frequent and convenient service furnished by the interurban lines, it is not necessary to offer an additional inducement in the way of a reduction of fares.

Most roads, it is found, do not make any reduction on one-way tickets. In other words, most roads are charging the maximum 2 cents per mile cash fare for one-way trips, making no reduction when tickets are purchased. Reductions are given in most cases on commutation tickets and mileage books. This practice is quite general, and, indeed, is almost universal where roads charge 2 cents per mile. There are a few roads charging less than 2 cents per mile which do not give any reduction. However, in almost all cases where an excess cash fare is charged over the one-way ticket fare, the tickets sold represent about 90 per cent of the total one-way fares.

Prepayment fare operation.—At the meeting of the New York State Electric Railway Association in 1913, reference was made to the results obtained in fare collection by the prepayment method, or "pay-as-you-enter" plan. A notable demonstration of its value was made by the introduction of prepayment cars on the Fifty-ninth Street line of the Third Avenue Railway, New York. The change from the ordinary nonprepayment car, made overnight, resulted in a revenue increase of 9½ per cent, notwithstanding the fact that the car mileage was reduced 4½ per cent. The annual report of the Chicago Railways Co. for the year ended January 31, 1912, showed an increase in gross receipts of 63 per cent during the preceding four years. There are some 1,500 pay-as-you-enter cars in that company's service, and while this increase in receipts can partly be accounted for through the normal growth of Chicago, and of the railway's business, a considerable margin must be attributed to improvement in fare collection. The fare box has been extensively introduced as an adjunct to prepayment operation. The value of this apparatus is contained in its moral influence on the conductor, and when it fails mechanically its influence and many nickels are lost at the same time. The remarkable development of the fare box indicates that mechanical failures are few and general cost of upkeep is becoming very low. On the Third Avenue Railway, New York City, for instance, two men suffice to maintain in mechanical efficiency about 550 boxes.

An interesting method or system of fare-box collection has been in use on the lines of the Rhode Island Co. in Providence for six or seven years, nearly 1,000 boxes being now in service. The register is carried by the conductor. It weighs but 21 ounces, and is a small nickel-plated box having a coin slot on one side, through which the passenger inserts the nickel, the coin being drawn into the device by the mechanism of the register as soon as its edge touches certain levers within the slot, whereupon the fare is registered automatically. The coin passes entirely through the register immediately after it enters the receiving slot, ringing a bell in the register as it is recorded, and is delivered into an open receiving compartment at the bottom of the device, thus becoming available for making change. When the coin has once entered the slot it can not be withdrawn but must pass through the register into the receptacle beneath. The entrance to the passage is automatically closed by the descent of the coin, and no additional coin can be inserted until the resetting of the opening by the conductor.

The equipments carry two totalizing registration counters, one for nickels and one for dimes, and in the latest type of register an additional counter is provided for metal tickets. It is not intended, however, that the public should pay fares in dimes, and while the dime-registration apparatus is built to withstand the same hard service as that imposed upon the nickel-recording mechanism, the rules of the company require nickel payments alone. Signs carrying instructions for passengers as well as a request for them to have nickels ready for payments are posted in all of the Providence cars. It is, however, possible for the conductor to make change and to use both hands in so doing, since the register is provided with a ring through which the conductor passes his middle finger, and when both hands are required the register is allowed to turn upon the finger and drop after the manner of the ordinary transfer punch.

With this system the conductor has nothing to do with the registration and does not handle the money until after it is registered. While the passenger and the conductor appear to be alone in this exchange of money for service, the company is actually present interposing the register between them. The registration mechanism is sealed at the factory, and traffic records are obtained by subtracting successive readings. On the lines of the Rhode Island Co. and elsewhere, experience with this system shows, it is said, that at least 90 per cent of fares formerly lost to the company are saved by its use.

The register is in no sense a money container. It operates in full view of the conductor and the passenger, can be held in any position or at any angle best suited to the passenger's convenience or to the conditions prevailing in the car, and accommodates in its lower receptacle eight or ten fares, or at least as many as a conductor would ever accumulate with his outstretched hand before examining and pocketing them. The registration has a total capacity of 99,999 nickel readings.

The conductor stands behind the railing in the platform vestibule, and the portable character and small size of the register are important points in the facility with which traffic can be handled. The space taken up is negligible, and in case the conductor is obliged to make change for one or more passengers in an entering line he can save time by presenting the register to others in the line without waiting for all to pass a predetermined point. Actual counts show that 80 passengers have been loaded and their fares all taken in two minutes on a single car making a stop in front of a large factory at closing time. In some cases individual registers handle as many as 3,000 fares per day.

Apart from the accuracy of the system and its removal of temptation from the conductor, it saves the conductor time otherwise consumed in manipulating the register cord or bar, and also obviates the false registration of fares by passengers who mistake the register cord for the bell cord. On the older cars of the Rhode Island Co. the conductor makes the usual personal collection from passengers on the inside, and the use of the portable register has been found a convenience to the public through its avoidance of jerky attempts on the part of short conductors to reach the ordinary register cord. The collection of fares by this method on crowded open cars has been very successful. No new printed reports of any kind were required in Providence on account of the adoption of this system. Conductors use the same trip sheets as before. Registers are leased by the maker on terms which cover inspection and repairs. It has been found that in the extremely few cases where a register has been stolen the conductor has found the theft so great a burden that the register has been anonymously returned.

In the report of the committee of the American Electric Railway Association on fares and transfers, presented at the meeting in October, 1913, some interesting data were given as to fare boxes. Replies to inquiries were received from 63 companies. Of these, 31 reported gross receipts annually of less than $1,000,000, the remainder having receipts greater than that amount. The use of prepayment cars was reported by 60 per cent of the smaller companies and 80 per cent of the larger ones, a total of 45, or 71 per cent of the whole number. The practice of the 45 companies operating prepayment cars was shown by the replies to be about equally divided as to the use or nonuse of fare boxes. A further equal division was found with respect to the locked and the nonlocked box, the former being the type which renders fares inaccessible to the conductor; and the same condition was found in regard to the use of fare-box registers. Four companies using a nonregistering locked box used a fare register on the car, and six companies did not use such a register under such conditions. Nine companies used fare registers besides registering fare boxes, and two did not.

The reasons given for use of fare boxes of the various types are as follows: Eight companies favor the registering nonlocked fare box because the change is available for the conductor, and four give other reasons. Two companies are using both types of boxes, but each prefers the registering fare box because it delivers money to conductors and gives them available change. Seven companies favor the locked fare box mainly on account of its cheapness and simplicity. One company was experimenting with both types, and one with a registering nonlocked box. Most of the locked nonregistering fare boxes receive any coin; three take cents, nickels, and dimes; and one, nickels, dimes, and quarters. Twelve of the registering nonlocked boxes take cents, nickels, and dimes; two take nickels and dimes only.

As to transfers, it was found by the committee that the majority of the smaller companies, such as issued less than 60,000 transfers daily, did not issue transfers on transfers, but that the larger companies did so, though in the majority of cases the retransfer privilege was limited. The majority of the smaller companies registered transfers, although the reverse was the case with the larger ones. A separate or double register was used in most cases for this purpose.

Most of the companies which followed the practice of registering transfers reported more or less effort to verify collections with register readings, and discipline for failure to register transfers in the same manner as in the case of failure to register fares. The general consensus seemed to be that it was impracticable to do more than check, in a general way, the number of transfers issued, destroyed, or given away, particularly when a large number of transfers was involved.

A difference of policy was observed in checking transfers to determine whether they had been properly honored by the conductor. Certain of the roads receiving but a few thousand transfers daily checked them out with care as to date, time, direction, etc., while some roads receiving less than a thousand transfers a day either made no check at all or made it at infrequent intervals only.

About half of the companies reported that a conductor who had improperly honored transfers was called before the superintendent or his representative. Two companies gave demerits in such cases. Several reported that men were cautioned and subsequently disciplined for repetition of the offense, while 12 companies charged the conductor for each irregularity.

The percentage of transfers given to conductors and not issued varied between the approximate limits of 15 per cent and 50 per cent, although in some cases this percentage was reported to be actually nothing. The proportion of issued transfers which were finally collected varied between the approximate limits of 75 per cent and 95 per cent, decreasing on the larger roads.

From the replies received the committee was of the opinion that the transfer which provides for the indication of the month and day by punch and notch marks is well adapted for use on those lines where the number of transfers honored daily is relatively small. The transfers which are stamped or printed with a figure to indicate the day of the month are somewhat more subject to waste. The transfers which are perforated by a machine before being given to a conductor are not quite as economical as either of the other two types of transfers, but obviously involve less waste than those which bear the printed day and month and are only good for one particular day. The dated transfer which may be used only on one day involves more waste than any of the preceding types of transfers mentioned, and as it involves the use of more than one standard form of transfer, it opens the way to additional abuse; but there may be certain local conditions which offset these undesirable features. The coupon transfer is expensive, but it appears to possess marked advantages in cases where a passenger is permitted to transfer more than once.

The discussions that took place at the convention revealed an absence of unanimity in regard to these important matters, indicative of the difficulty of reaching any standard practice. For example, Mr. W. F. Ham, Washington (D. C.) Railway & Electric Co., said that his company was probably one of the few that had not experimented extensively in the use of fare boxes. That, however, should not be taken as a condemnation of the use of fare boxes, but simply as a statement that in the city of Washington the fare box did not seem to be of value, because of the fact that about 80 or 85 per cent of the business was done on tickets, leaving only about 15 per cent on a cash basis. So far as his experience had gone, the company felt that it could do better without the use of the fare box. To show, however, how different people reached different conclusions, Mr. Ham said that at about the same time that his company did away with the fare box the Capital Traction Co., operating in the same city, adopted it, and had practically the same conditions to contend with. Hence there was no unanimity of opinion in Washington as to whether fare boxes were good or bad. According to his experience they did not give good results, and while he thought that his company did not have the best kind of a fare box, still there was nothing in it that looked particularly attractive and it was decided to give up the use of the device. His company had used both registering and nonregistering boxes.

APPENDICES

Appendix A.—SCHEDULES: CENTRAL ELECTRIC LIGHT AND POWER STATIONS AND STREET AND ELECTRIC RAILWAYS

Appendix B.—INSTRUCTIONS TO SPECIAL AGENTS

APPENDIX A.

SCHEDULES: CENTRAL ELECTRIC LIGHT AND POWER STATIONS AND STREET AND ELECTRIC RAILWAYS: 1912.

CENSUS OF ELECTRIC LIGHT AND POWER STATIONS.

(All central electric light or power stations, including municipal stations, should be reported on this schedule. No report is required for isolated electric plants operated for the exclusive benefit of the owner in lighting or furnishing power for his factory, hotel, or other enterprise. *Isolated plants which incidentally sell current must be reported.*)

Name of company or plant..

Location of plant: State........................ County........................

Location of plant: City or town................ Street and No................

General office (give state, city, street, and number)........................

(Light and power plants operated by the same corporation, firm, or individual, and located in different states, counties, cities, or towns, should be separately reported.)

AUTHORIZATION.

The act of Congress approved June 7, 1906, authorizes the Director of the Census to collect every fifth year statistics relating to the electric industries, including electric light and power stations and electric railways. The act approved July 2, 1909, directs that it shall be the duty of every owner, president, treasurer, secretary, director, or other officer or agent of any establishment or company covered by the census inquiry to furnish the information indicated by the schedules that have been prepared in conformity with these requirements.

The last census of electric light and power stations covered the year 1907, and this schedule has been prepared for the census of 1912. The statistics should relate to the calendar year ending December 31, 1912. Except in the case of number of employees, all questions that relate to a single date, such as cash on hand, number of lamps, etc., should be of the date of the last day of the year covered by the report.

The answers to inquiries in regard to financial matters will be held absolutely confidential; the separate reports will be combined so as to show totals for all companies in each state. The information will be used only for the statistical purposes for which it is given, and will not be disclosed to any individual, state or local authority, or other Bureau or Department of the Federal Government.

E. Dana Durand,
Director of the Census.

CERTIFICATE.

This is to certify that the information contained in this schedule is complete and correct to the best of my knowledge and belief, and it covers the period from .... 19 , to........, 19 .

....
(Signature and official designation of the person furnishing the information.)

....
(Signature of special agent.)

....
(Address of person furnishing the information.)

Each question should be answered; if not applicable, use word "None."

In case of electric light and power plants operated in connection with electric railways, a separare report for the electric light and power service should, if possible, be made on this schedule. If it is impossible to make complete separate reports for each, one combined report for railways and light and power plants may be made on the railway schedule.

If electric light and power plants are operated in connection with any business other than railways, and the accounts are not kept separate, careful estimates must be prepared for answers to all questions contained in this schedule. In these cases the items reported for income and expenses, balance sheet, and employees, salaries, and wages, must pertain only to the electric light and power plant department.

1. Character of organization: State the form of organization as it existed on the last day of the year covered by the report, whether individual, firm or partnership, incorporated company, municipal, or other form........................
2. If a controlling company, write on the last page of the schedule the names and addresses of subsidiary or leased companies for which report is included in this return.
3. If a subsidiary or leased company, give name and address of operating company or lessee........................
4. If the corporation or firm is engaged in any business or industry other than that of central station work for electric light and power, state the character of such business or industry, and whether conducted in the same or separate plants..

....

EQUIPMENT.

5. Number of lamps: Account for all lamps wired for service, including as commercial or private those used by company to light its own properties. If actual number is not known, give careful estimate.

	Number.			
	Total.	Street lighting.	Public buildings.	Commercial or private.
Arc lamps........	....	....	....	....
Incandescent lamps........	....	....	....	....
Other varieties (give name, such as Nernst, vacuum, vapor, etc.)........	....	....	....	....
....	....	....	....	....

6. Miscellaneous statistics.	Number.
Number of stationary motors served (do not include small fan motors)	....
Total capacity in horsepower........	....
Recording meters on consumption circuits........	....
Total number of customers furnished electric current during the year....	....

7. Power-plant equipment: Include all generating units in all the plants covered by the report, and give the total horsepower for *all* included in each group.

Generating power plant.	Total.	500 H. P. or under.	Over 500 H. P. and under 2,000 H. P.	2,000 H. P. and under 5,000 H. P.	5,000 H. P. and over.
Steam engines (not turbines), number..	....	....	....	....	....
Total capacity in horsepower........	....	....	....	....	....
Steam turbines, number........	....	....	....	....	....
Total capacity in horsepower........	....	....	....	....	....
Gas and oil engines, number........	....	....	....	....	....
Total capacity in horsepower........	....	....	....	....	....
Water wheels and turbines, number....	....	....	....	....	....
Total capacity in horsepower........	....	....	....	....	....

8. Electrical generators: Give the total number of each of the three kinds of dynamos, and the total rated capacity in kilowatts of all machines of each class.

	Number.	Total rated capacity in kilowatts.
Dynamos:		
Direct current, constant voltage........	....	....
Direct current, constant amperage........	....	....
Alternating and polyphase current........	....	....

9. Output of station: The output must be obtained from the load voltage and amperage, or from the actual watt or kilowatt reading of dynamo meters.

Total kilowatt-hours generated for year..

Total kilowatt-hours purchased during year..

10. Substation equipment: Include equipment in main power plant, as well as that in separate substations. Give total number of each class of machines and total rated capacity in kilowatts for all machines of each class.

	Number.	Total rated capacity in kilowatts.
Rotary converters and motor generator sets		
Boosters		
Storage battery cells		
Transformers		
Auxiliary generators		
Miscellaneous machines (state kind)		

FINANCIAL STATISTICS.

11. Revenue and income account: Give actual amounts carried on income account statement. This may include income and expenses properly belonging in but not actually received or paid during the year, and therefore need not agree with a cash statement. If accounts do not show the income for each class of service indicated, give a carefully estimated segregation, and state that it is an estimate. *Do not* include the value of electricity furnished free of charge to municipal or other government, or of current consumed by lamps and motors on the company's properties. The extimated value of the free service should be given only in answer to Inquiry 12. The inquiry is not intended to cover commercial transactions in electric supplies, but where the company incidentally sells supplies to its customers the profits on the merchandise sales should be included. Account for all expenses incident to the operation and maintenance during the year covered by the report. Salaries and wages must be included, and also shown as a separate item in answer to Inquiry 13.

REVENUE.

Electric service:	
Commercial or private light, power, and heat	$
Municipal street lighting, both arc and incandescent	
Municipal building lighting	
Sale of electric current to other public service corporations	
Interest and dividends from investments	
All other income, including rents and profits on merchandise sales	
Total	$

EXPENSES.

Supplies and materials used for ordinary repairs or replacement, and salaries and wages (as shown in answer to Inquiry 13)	$
Fuel	
Electric current and power purchased	
Rent of offices, stations, line-wire supports, conduits, underground and water privileges	
All other expenses incident to operation and maintenance, such as advertising, law expenses, telegraph and telephone service, power other than electric, ordinary repairs of buildings, machinery, and and lines, and miscellaneous items	
Taxes:	
Real and personal property	
Capital stock	
Federal corporation tax	
Earnings	
Miscellaneous (specify items)	
Interest on funded and floating debt and mortgages	
Injuries and damages, and legal expenses incident thereto	
Insurance	
Charges for depreciation, if any	
Charges for sinking fund, if any (if charged against income)	
Total	$
Dividends declared during the year: On common stock	
Dividends declared during the year: On preferred stock	

12. Free service: Give the estimated value of current supplied free to municipalities or other government by either commercial or municipal plants. The estimate must be based upon the prevailing commercial rates. Do not include these amounts in the answer to Inquiry 11.

If the report is for a commercial company, give the estimated value of free service furnished municipal or other government.............. $..........

If the report is for a municipal plant, give the amount of estimated income represented by current consumed in lighting streets, parks, public buildings, etc., for which no income is received.............. ....

13. Employees, salaries, and wages: The salaries and wages reported here should be the total amount paid during the year, and should also be included in the amount reported for the first item of expense under Inquiry 11. Account for all regular officers and employees, whether engaged on maintenance, operation, canvassing, collecting, or otherwise. General superintendents or other heads of departments, if considered as salaried officers of corporations, may be reported as such. Do not include employees engaged exclusively on additions or extensions. Overseers and foremen performing work similar to men over whom they have charge must be included with wage earners. Those whose duties are wholly supervisory should be reported as salaried employees. If possible, *give number employed on September 16, 1912, as per pay roll.* If data are not available for that day or month, give the data for nearest representative or normal day, and state day and month here..............................

	Number Sept. 16, 1912.	Salaries and wages for year.
Salaried employees:		
Salaried officers of corporations		$
Superintendents and managers		
Clerks, stenographers, and other salaried employees		
Total for salaried employees		$
Wage earners (do not include salaried employees reported above)		

14. Balance sheet.

Assets.		Liabilities.	
Kind.	Amount.	Kind.	Amount.
Cost of construction, equipment, and real estate	$	Capital stock: Common	$
		Capital stock: Preferred	
Stocks and bonds of other electric companies		Funded debt	
Stocks and bonds of companies other than electric companies		Cash investment (for unincorporated companies)	
Treasury securities: Stock		Real estate mortgages	
Treasury securities: Bonds		Floating debt (loans and notes)	
Other permanent investments (specify)		Reserves	
		Accounts payable	
Cash and current assets, including supplies		Interest and taxes due and accrued	
Stock and bond discount		Dividends due	
Sinking and other special funds		Sundries (specify principal items)	
Sundries (specify principal items)			
		Profit and loss surplus	
Profit and loss deficit		Total	$
Total	$		

CENSUS OF STREET AND ELECTRIC RAILWAYS.

OPERATING COMPANIES.

(All electric railways and all street railroads, irrespective of kind of motive power, should be reported on this schedule. Nonoperating and lessor railway companies should be reported on schedule.)

Name of company..

....

State in which operated.................. Post office of general office..............

Post office of local operating office..

AUTHORIZATION.

The act of Congress approved June 7, 1906, authorizes the Director of the Census to collect every fifth year statistics relating to the electric industries, including electric railways and electric light and power stations. The act approved July 2, 1909, directs that it shall be the duty of every owner, president, treasurer, secretary, director, or other officer or agent of any establishment or company covered by the census inquiry, to furnish the information indicated by the schedules that have been prepared in conformity with these requirements.

The last census of electric railways covered the year 1907, and this schedule has been prepared for the census of 1912. The statistics should relate to the calendar year ending December 31, 1912. Except in the case of number of employees, all questions that relate to a single date, such as mileage of track, cash on hand, etc., should be of the date of the last day of the year covered by the report.

The answers to inquiries in regard to financial matters will be held absolutely confidential; the separate reports will be combined so as to show totals for all companies in each state. The information will be used only for the statistical purposes for which it is given, and will not be disclosed to any individual, state or local authority, or other bureau or department of the Federal Government.

E. DANA DURAND,
Director of the Census.

CERTIFICATE.

This is to certify that the information contained in this schedule is complete and correct to the best of my knowledge and belief, and it covers the period from ...., 19.., to ...., 19...

(Signature and official designation of the person furnishing the information.)

....
(Signature of specialent.)

....
(Address of person furnishing the information.)

Each question should be answered; if not applicable, use word "None."

In case of electric light and power plants operated in connection with electric railways, a separate report for the electric light and power service should, if possible, be made on schedule Form B 3—450. If it is impossible to make complete separate reports for each, one combined report for railways and light and power plants may be made on this schedule, showing the number of lamps, income, etc., of the light and power plants as called for by Inquiries 17 to 19.

1. Write on the last page of the schedule the names of all companies reorganized, consolidated, or merged into the reporting company since December 31, 1907.
2. If a controlling company, write on the last page of the schedule the names and addresses of subsidiary or leased companies for which operating report is included in this return. (If a nonoperating and lessor company, separate report must be made on schedule Form A 3—449.)
3. If a subsidiary or leased company, give name and address of operating company or lessee..
4. Is electric current generated for sale for light or power?.......... If so, is there a separate power plant or line construction?.......... Are data for electric light and power plant included in this report, or is separate report made for same? ....

PLANT.

5. Track: For "Leased" give the track leased for the sole use of the reporting company; for "Trackage rights or contract" give the track used jointly with other companies under such arrangement. (The totals reported for the different sections must agree with each account for the total track operated.) If track is *owned* jointly and other companies, make a note of the fact and give the names of the companies and the miles of track owned in this manner.

	Owned.	Leased.		Operated under trackage rights or contract.		Total operated (in miles and decimals of a mile).
		From electric companies.	From steam companies.	From electric companies.	From steam companies.	
Length of road (first main track)						
Length of second and other main track (including third and fourth)						
Total length of main track						
Length of sidings and turnouts, including car houses, storage yards, etc						
Total length of all tracks						[A]

5. Track—Continued.

Classification of track: In order to eliminate duplications in the statistics trackage of each kind operated under trackage rights, if any, should be stated in the column provided; such trackage being also included with the total operated.	Trackage, if any, operated under trackage rights.	Total miles of track operated.
Overhead trolley		
Conduit trolley		
Third rail		
Cable		
Steam		
Animal		
Self-propelled cars		
Other (state kind)		
Total (should agree with total track [A] above)		

	Total miles of track operated.
City and suburban lines	
Interurban lines (the total for city and suburban and interurban lines should agree with the total track [A] above)	
On private right of way owned or leased by reporting company	
On private right of way not owned or leased by reporting company, including that operated under trackage rights or contract	
Elevated	
In subways and tunnels	

6. If track extends into more than one state, give the number of miles of track in each state: The total operated as reported (item marked [A]) should be segregated by states..

7. Cars: Account for all cars operated, ready for operation, or being repaired. Cars reported as "Express, freight, mail, and baggage cars" must be devoted solely to one or more of these specified uses. Parlor, sleeping, dining, and private cars should be included as passenger cars.

Class.	Number.
Passenger cars:	
Closed	
Open	
Combination (closed and open)	
Combination (passenger, with baggage, express, freight, or mail)	
Total passenger cars	
Prepayment (all cars of this type should be included above but here shown separately)	
Parlor, sleeping, dining, private, etc. (should be included above as passenger cars but here shown separately)	
Other cars:	
Express, freight, mail, and baggage	
Miscellaneous (work cars, snow plows, sweepers, etc.)	
Electric locomotives	
Total other cars	
Kind of brakes (if the total of these two items does not account for all cars, the discrepancy should be explained):	
Cars equipped with hand brakes exclusively	
Cars equipped with other types of brakes including air brakes	
Cars equipped with one motor........; two motors........; three motors........; four motors........	

8. Power-plant equipment: Include all generating units in all the plants covered by the report, and give the total horsepower for *all* included in each group.

Generating power plant.	Total.	500 H. P. or under.	Over 500 H. P. and under 2,000 H. P.	2,000 H. P. and under 5,000 H. P.	5,000 H. P. and over.
Steam engines (not turbines), number					
Total capacity in horsepower					
Steam turbines, number					
Total capacity in horsepower					
Gas and oil engines, number					
Total capacity in horsepower					
Water wheels and turbines, number					
Total capacity in horsepower					

9. Electrical generators: Give the total number of each of the three kinds of dynamos, and the total rated capacity in kilowatts of all machines of each class.

	Number.	Total rated capacity in kilowatts.
Dynamos:		
Direct-current, constant voltage		
Direct-current, constant amperage		
Alternating and polyphase current		

10. Output of station and current purchased: The output must be obtained from the load voltage and amperage, or from the actual watt or kilowatt reading of dynamo meters at the switchboard.

Total kilowatt-hours generated for year

Total kilowatt-hours purchased during year

11. Substation equipment: Include equipment in main power plant, as well as that in separate substations. Give total number of each class of machines and total rated capacity in kilowatts for all machines of each class.

	Number.	Total rated capacity in kilowatts.
Rotary converters and motor generator sets		
Boosters		
Storage battery cells		
Transformers		
Auxiliary generators		
Miscellaneous machines (state kind)		

12. Traffic and mileage: In computing car mileage the individual car should be considered the unit. Motor and one trailer can be treated as a unit, if this is the practice of the company. In that case, please state the fact on the last page of the schedule. Train mileage should not be reported as such.

	Number.
Revenue passengers carried	
Transfer passengers carried	
Free passengers carried (give estimate of total number for year)	
Total passengers carried	
Revenue car mileage of passenger cars, including combination passenger and baggage, express, or mail cars	
Express, mail, and freight car mileage	
Total revenue car mileage	

12. Traffic and mileage—Continued.

	Number.
Revenue car-hours of passenger cars, including combination passenger and baggage, express, or mail cars	
Express, freight, and mail car-hours	
Total revenue car-hours	
Revenue passengers per mile of track operated	
Revenue passengers carried per revenue passenger car-mile	
Revenue passengers carried per revenue passenger car-hour	
Fare charged per passenger within city limits: City	
Fare	
(If line operates in two or more cities, give names of cities, and fare charged in each. If reduced fare is granted by sale of tickets or otherwise, give each rate with short statement of the facts.)	

FINANCIAL STATISTICS.

The following inquiries relating to financial operations conform generally to the system of accounting adopted by the United States Interstate Commerce Commission and by the American Electric Railway Accountants' Association. The marginal numbers correspond with the account numbers given in the official classifications of accounts used by the Interstate Commerce Commission. All companies, irrespective of their size, should report on this form.

13. Revenue and income account: Give actual amounts carried on income account statement. This may include income and expenses properly belonging in but not actually received or paid during the year, and therefore need not agree with a cash statement. If accounts do not show the income from each source enumerated, give a carefully estimated segregation, and state that it is an estimate.

REVENUE.

1. Passenger revenue	$	
3. Parlor, chair, and special car revenue		
7. Freight revenue		
4. Mail revenue		
2, 5, 6. Baggage, express, and milk revenue		
8, 9. Other transportation revenue		
18. Sale of electric current for light or power, including sale of current to other public service corporations		
10–17, 19. Other nontransportation revenue		
Total operating revenues (use this total in computing "Operating revenues per car-mile")		$
Interest on bonds and dividends on stock of other electric railways		
Income from other permanent investments		
Other miscellaneous income (specify principal items)		
Total miscellaneous income		
Total income from all sources		$
Operating revenues per car-mile (to be based on "Total operating revenues")		

EXPENSES.

Total operating expenses (from Inquiry 14)		$
Taxes:		
Real and personal property	$	
Capital stock		
Federal corporation tax		
Earnings		
Miscellaneous (specify items)		
Total taxes		
Interest on funded and floating debt and mortgages		
Rent of leased lines and terminals		
Charges for sinking fund, if any		
Miscellaneous (specify principal items)		
Total operating expenses and fixed charges		
Net income (or deficit) for the year		$
Dividends declared during the year: On common stock		
Dividends declared during the year: On preferred stock		
Surplus (or deficit) from operations of year		
Surplus (or deficit) at beginning of year		
Profit and loss adjustments during year		
Surplus (or deficit) Dec. 31, 1912		

14. Operating expenses.

Account.	Amount.
Way and structures:	
1. Superintendence of way and structures	$
2–19. Maintenance of way	
20–24. Maintenance of electric lines	
25. Buildings and structures	
26. Depreciation of way and structures	
27, 28. Other operations—Dr. or Cr. (For adjustment with lighting plant or other department if separate accounts are kept)	
Total, way and structures	
Equipment:	
29. Superintendence of equipment	
30, 31. Maintenance of power equipment	
32–35. Maintenance of cars and locomotives	
36, 37. Maintenance of electric equipment of cars and locomotives	
38–41. Miscellaneous equipment expenses	
42. Depreciation of equipment	
43, 44. Other operations—Dr. or Cr. (For adjustment with lighting plant or other department if separate accounts are kept)	
Total, equipment	
Traffic:	
45–47. Traffic expenses	
Conducting transportation:	
48. Superintendence of transportation	
GROUP I—POWER.	
49. Power-plant employees	
50. Substation employees	
51. Fuel for power	
52–55. Other power supplies and expenses	
56. Power purchased	
57. Power exchanged—Balance	
58, 59. Other operations—Dr. or Cr. (For adjustment with lighting plant or other department if separate accounts are kept)	
GROUP II—OPERATION OF CARS.	
60, 61. Conductors, motormen, and trainmen	
62–72. Miscellaneous transportation expenses	
Total, conducting transportation	
General and miscellaneous:	
73–79. General expenses	
80, 81. Other operations—Dr or Cr. (For adjustment with lighting plant or other department if separate accounts are kept)	
82. Injuries and damages	
83. Insurance	
84. Stationery and printing	
85, 86. Store and stable expenses	
87. Rent of tracks and terminals	
88. Rent of equipment	
Total, general and miscellaneous	
Recapitulation of expenses:	
Way and structures	
Equipment	
Traffic	
Conducting transportation	
General and miscellaneons	
Total operating expenses	$

15. Balance sheet.

Assets.		Liabilities.	
Kind.	Amount.	Kind.	Amount.
Cost of construction, equipment, and real estate	$	Capital stock Common	$
Stocks and bonds of other electric railway companies		Capital stock Preferred	
Stocks and bonds of companies other than electric railways		Funded debt	
Treasury securities Stock		Real estate mortgages	
Treasury securities Bonds		Floating debt (loans and notes)	
Other permanent investments (specify)		Reserves	
		Accounts payable	
Cash and current assets, including supplies		Interest and taxes due and accrued	
Stock and bond discount		Dividends due	
Sinking and other special funds		Sundries (specify principal items)	
Sundries (specify principal items)			
Profit and loss deficit			
Total	$	Profit and loss surplus	
		Total	$

16. Employees, salaries, and wages: The salaries and wages reported here should be the total amount paid during the year and should also be included in the amounts reported for the different items under Inquiry 14. Account for all regular officers and employees, whether engaged on maintenance, operation, canvassing, collecting, or otherwise. Salaried officers of corporations should include president, vice presidents, secretary, assistant secretaries, treasurer, assistant treasurers, general auditor, assistant general auditors, auditors, assistant auditors, counsel, and similar officials. Managers and superintendents should include general managers, assistant general managers, managers, general superintendents, assistant general superintendents, superintendents, assistant superintendents, superintendents of maintenance of way, superintendents of construction, and similar employees. Clerks and stenographers and other salaried employees should include clerks, stenographers, civil engineers, electrical engineers, mechanical engineers, purchasing agents, cashiers, claim agents, dispatchers, starters, inspectors, master mechanics, and similar employees. Do not include employees engaged exclusively on additions or extensions. Overseers and foremen performing work similar to men over whom they have charge must be included with wage earners. Those whose duties are wholly supervisory should be reported as salaried employees. If possible, *give number employed on Sept. 16, 1912, as per pay roll.* If data are not available for that day or month, give the data for nearest representative or normal day, and state day and month here

	Number Sept. 16, 1912.	Salaries and wages for year.
Salaried employees:		
Salaried officers of corporation		$
Managers and superintendents		
Clerks, stenographers, and other salaried employees		
Total		$
Wage earners:		
Conductors		
Motormen		
All other employees		
Total		$

Additional questions for electric railways which operate separate electric light and power plants. The following questions should be answered if there is a separate power plant or line construction for which a complete separate report can not be prepared as provided for by instructions at top of page 2.

17. Number of lamps: Account for all lamps wired for service, including as commercial or private those used by company to light its own properties. If actual number is not known, give careful estimate.

	Number.			
	Total.	Street lighting.	Public buildings.	Commercial or private.
Arc lamps				
Incandescent lamps				
Other varieties (give name, such as Nernst, vacuum, vapor, etc.)				

18. Income: Give total income from electric light and power department. The income reported here should also be included under Inquiry 13, "Revenue and income account."

Income—Continued.

	Amount.
Electric service:	
Commercial or private light, power, and heat	$
Municipal street lighting, both arc and incandescent	
Municipal building lighting	
Sale of electric current to other public service corporations	
Profit on merchandise sales	
Income from other sources for this department	
Total	$

19. If free electric service is furnished municipality or other government, give estimate of total amount that would have been received for the same, based upon the prevailing commercial rates $

NONOPERATING AND LESSOR COMPANIES.

(Nonoperating and lessor electric railway companies should be reported on this schedule. This class includes all companies that have leased their properties to other companies for a given period at a definite rental, or under an agreement for the payment of the interest on the bonds and fixed dividends on the stock of the lessor company, or under some other arrangement that relieves the lessor of the supervision of operation. The operating companies should be reported on schedule Form A4-451. If properties are leased to two or more operating companies, separate reports should be made on this schedule for each.)

Name of company

State in which operated Post office of general office

Name and address of operating company

AUTHORIZATION.

The act of Congress approved June 7, 1906, authorizes the Director of the Census to collect every fifth year statistics relating to the electric industries, including electric railways and electric light and power stations. The act approved July 2, 1909, directs that it shall be the duty of every owner, president, treasurer, secretary, director, or other officer or agent of any establishment or company covered by the census inquiry, to furnish the information indicated by the schedules that have been prepared in conformity with these requirements.

The last census of electric railways covered the year 1907, and this schedule has been prepared for the census of 1912. The statistics should relate to the calendar year ending December 31, 1912. All questions that relate to a single date, such as cash on hand, should be of the date of the last day of the year covered by the report.

The answers to the inquiries will be held absolutely confidential; the separate reports will be combined so as to show totals for all companies in each state. The information will be used only for the statistical purposes for which it is given, and will not be disclosed to any individual, state, or local authority, or other bureau or department of the Federal Government.

E. Dana Durand,
Director of the Census.

CERTIFICATE.

This is to certify that the information contained in this schedule is complete and correct to the best of my knowledge and belief, and it covers the period from ...., 19 , to ...., 19 .

(Signature and official designation of the person furnishing the information.)

(Signature of special agent.)

(Address of person furnishing the information.)

Each question should be answered; if not applicable, use word "None."

1. Track.

	Total miles of track.
Length of road (first main track)	
Length of second and other main tracks (including third and fourth)	
Total length of main track	
Length of sidings and turnouts, including car houses, storage yards, etc	
Total length of all track	

2. Income account: Give actual amounts carried on income account statement of company. This may include income and expenses properly belonging in, but not actually received or paid during the year, and therefore need not agree with a cash statement.

Income:		
Rentals from operating companies	$	
Miscellaneous income (specify principal items)		
Gross income		$
Deductions from income:		
Interest on funded debt		
Miscellaneous deductions (maintenance of organization, etc.)		
Net income		$
Dividends		
Surplus		

3. Balance sheet.

Assets.		Liabilities.	
Kind.	Amount.	Kind.	Amount.
Cost of construction, equipment, and real estate	$	Capital stock Common	$
Stocks and bonds of other electric railway companies		Capital stock Preferred	
Stocks and bonds of companies other than electric railways		Funded debt	
Treasury securities Stock		Real estate mortgages	
Treasury securities Bonds		Floating debt (loans and notes)	
Other permanent investments (specify)		Reserves	
		Accounts payable	
Cash and current assets, including supplies		Interest and taxes due and accrued	
Stock and bond discount		Dividends due	
Sinking and other special funds		Sundries (specify principal items)	
Sundries (specify principal items)			
Profit and loss deficit		Profit and loss surplus	
Total	$	Total	$

APPENDIX B.

INSTRUCTIONS TO SPECIAL AGENTS.

LISTS AND CANVASS OF ESTABLISHMENTS.

Unlisted establishments.—Although the list of establishments furnished special agents has been made as complete as possible, it has not been practicable to secure absolute accuracy and completeness, and *special agents must be constantly on the alert to discover plants not named on the list. They will be held strictly accountable for a complete canvass of the district to which they are assigned.* They must make careful inquiry for other plants located in that vicinity.

The agents must account for all of the names on the list. A return must be secured for each establishment not already disposed of by mail or a satisfactory explanation given on the daily report. This explanation must be such as "Out of business, no successor," "Isolated plant, no current sold," or "Only — per cent sold." The explanation given on the daily report must be full and complete, leaving no doubt as to the conditions. The number of the establishment on the typewritten list must in all cases be written in the upper right-hand corner of the schedule and on the left-hand margin of the daily report.

Change in name of establishment.—If a change has been made in the name or location of the plant since the list was prepared, or if a report is secured for an establishment under a different name from that appearing on the list, the list must be changed to agree with the new conditions and this change must be stated on the daily report.

Idle plants.—All plants that commenced operations or did any work during the census year ending December 31, 1912, must be reported, although they may not have been in operation at the end of the year 1912. Reports are not required for plants which were closed or idle during the whole of the year. The circumstances, however, should be explained in the daily report of the agent.

Central offices.—A large number of properties are controlled from offices located elsewhere than at the plants. When known, central offices of this character and the names of the plants for which reports will be prepared at the central office are indicated on the lists. Agents canvassing the districts in which central offices are located must in every instance call at these offices for reports before canvassing the other plants. A return must be secured for every plant noted on the central office list. A large number of controlling companies have advised the office that reports for certain properties will be prepared at their office. The names of these properties will appear on the agent's list, but with a notation "See central office," or "Report will be secured at ———." Agents must not secure reports for these plants unless the central office is within their district, and then from the business office. If in the city the agent should call at such plants and explain that a census of electrical industries is being taken, also that it is understood the report is being prepared at the central office of the company. He should also leave blank schedules, explaining the requirements of the census, so that the local officials will know just what information is required if the central office requests them to furnish data for the reports. All of such visits should be noted on the agent's daily report.

If a plant is owned by a company whose business office is in another locality outside the territory assigned the agent and a portion of the information must be obtained from such office, the agent should complete the schedule so far as possible from the data obtainable at the plant and forward it to the Census Bureau with a full statement of the facts, giving also the names and addresses of the persons from whom further information can be obtained. The agent must, however, exhaust every reasonable means to complete the report before sending it in to the Census Bureau.

Annual reports.—In all cases where an annual report of the company is printed, a copy of the latest report should be secured and forwarded with the schedule. Copies should also be returned of the latest report of the directors or officers of the company, or other printed matter that would add to the information contained in the schedule.

Correction of reports.—An agent should not return to a city already canvassed to secure information for a report returned to him for correction unless especially advised to do so. It is believed that the agent will be able in most cases to supply the information from his knowledge of the conditions. If he can not do so, he should return the schedule to the Census Bureau with such explanation for his error or neglect as he may be able to make. To obviate the necessity of returning schedules for additional information, the agent must be careful to secure *complete* reports for all plants not already disposed of on his list before leaving a city.

METHOD OF SECURING SCHEDULES.

Reports secured by mail.—Schedules were mailed to all companies, and if a report has been thus received, the name on the agent's list will be marked "Schedule received." If the mail report is unsatisfactory, that fact will be indicated on the list and the original schedule furnished the agent to complete. These schedules must be completed or corrected, signed, and returned by the agent. If it is found advisable to prepare a new report in place of the original, such report must be marked "Corrected report" on the title-page, and the original marked "Void" and returned with the new report. Otherwise the agent will still be charged with the original schedule.

Promptness of agents.—In many cases the schedule mailed to the company to be made out and sent back to the office will not have been returned to the bureau and may not be ready when the agent arrives. In that event he should proceed to get the information immediately. If the agent has not been advised that the office is in receipt of any report, whether or not on his list, he must secure the same, although the company may claim that the schedule has been furnished.

TITLE OF SCHEDULES.

The electrical industries covered by the census of 1912 will be reported on the following schedules:

Electric railways.
Nonoperating and lessor electric railways.
Electric light and power stations.
Telephones (large commercial systems).
Telephone (short schedule for independent farmer or rural lines and small commercial systems).
Municipal electric fire-alarm and police-patrol signaling systems.
Telegraphs.

The reports for commercial telegraph companies will be collected wholly by correspondence. Reports for the industries covered by the other six schedules will be secured by the field force, and also by correspondence.

PREPARATION OF THE SCHEDULES.

Answers to inquiries to be taken from books of accounts and records.—The information secured must be accurate. In drafting the schedule every effort has been made to frame the inquiries in such a form that the answers to them can generally be taken directly from the books of accounts and records. The agent may find a disposition on the part of persons furnishing the information to give general statements or estimates, claiming that they approximate very closely the exact figures. In no case should these general statements or estimates be accepted where it is possible to secure the answers directly from the books of accounts and records. If the accounts cover two or more of the items enumerated for any of the inquiries, the total should be equitably apportioned for the reply to each subinquiry. In all cases where the answers are estimated the amounts must be preceded by the word "Estimate."

All answers must be made clearly and neatly in ink. Each question is to be answered. If any question is found not applicable and no amounts are reported, write the word "None."

Some of the inquiries require no explanation, but the following instructions, in addition to those on the schedules, should be followed by the agents in preparing all reports:

The title-page.—Page 1 must contain the name and location of the company, the address of the general office, and the signature, address, and official designation of the person furnishing the information. *Place the office number of the report in the upper right-hand corner.* If the address of the general or business office is at a different place from that of the plant, care must be taken to give both.

The period covered, where possible, should be that of the year ending December 31, 1912. Where, however, the business year of the establishment does not correspond to the calendar year, the data may be secured for such completed business year as corresponds most nearly to the calendar year 1912. The reports for plants that were in operation only a portion of the census year will be tabulated separately; therefore it is essential to give on the title-page the exact period covered by each report.

ELECTRIC RAILWAYS.

The schedule is prepared primarily for railways operated by electricity, as the greater number of street railways, including the most important, have adopted this form of motive power. All classes of street railways, whether operated in whole or in part by electricity, cable, animal, steam, or other motive power, and also interurban railways, must be reported on this form.

Reports to state officials.—In a number of states the electric railways make reports to state railroad commissioners or other state officials. In a few states arrangements will be made to copy the data contained in such reports. For such states special instructions will be given the special agents.

Combined reports for two or more systems.—In a number of instances independent street railway companies have recently been combined under one *ownership*. In such cases one report may be made for the operations of the entire system, but if the system of accounting will permit of the preparation of separate schedules a separate report should be secured for each of the constituent companies. In preparing separate reports for subsidiary companies the name and address of the controlling company must be given in answer to Inquiry 3. (See also instructions for "Separate reports for nonoperating and lessor electric railway companies," p. 432.)

Combined reports for railways and light and power plants.—A number of street railway companies generate electricity for sale to other roads, or for light, power, or other purposes. In such cases either a combined report or separate reports should be prepared, as provided for by the instructions at the top of page 2 and preceding Inquiry 17 of the schedule. Although separate reports are preferred, these should not be secured unless they can be made *complete*, with no cross references. If this can not be done, a combined report should be prepared on the railway schedule.

The first four inquiries must be answered, and special attention is called to Inquiry 4. The answer to this inquiry must show how the two industries, when carried on by the same company, have been reported.

INQUIRY 5.—TRACK.

The track reported in answer to the two sections of this inquiry must be given in miles and decimals of a mile carried to two places. The total miles reported for answer to the first section must cover the total track. "Single track" means one set of rails in any thoroughfare. "Second track" means another pair of rails running alongside the first, so that cars can pass each other in opposite directions. Even in some of the largest cities there will be but one track in one street, the return route running parallel on another street near by.

Be careful not to report as "operated under trackage rights or contract" any portion of the track operated under a lease and included in the column "Leased." The ownership (name and address of company) of leased track should be noted on the margin of the schedule.

The second section of the inquiry is divided into three parts. Each of the first two parts should account for the total miles of single track operated as reported in answer to the first section.

The miles of track reported in answer to the inquiries "City and suburban lines" and "Interurban lines" will depend upon the understanding of each company concerning the character of the road and territory served. These two items must account for the total miles of single track operated.

The answer to the last four inquiries cover only a portion of the track, as indicated by the following questions and instructions:

Track on private right of way owned or leased by reporting company.—Give the length in single-track miles of all tracks laid on ground owned by railway companies.

Track on private right of way not owned or leased by reporting company, including that operated under trackage rights of contracts.—Give length in single-track miles of all tracks laid on ground owned by individuals, firms, or corporations, other than railway companies. This must not include tracks laid on streets or public thoroughfares.

INQUIRY 6.—TRACK, BY STATES.

The statistics for miles of track must be shown by states; therefore when a company operates in more than one state the entire length of the road, including leased lines, must be segregated so as to show the number of single-track miles in each state. If track is operated under trackage rights or contract, the length so operated must be reported separately by states.

INQUIRY 7.—CARS.

The answers must account for all cars operated, ready for operation, or being repaired. Some cars may serve for more purposes than one, but they must not be counted twice. The total must be the actual number. Passenger cars used also for express, baggage, freight, or mail business must be reported as "Combination cars (passenger, with baggage, express, freight, or mail)." The cars reported as "Express, freight, mail, and baggage" cars must be devoted solely and specifically to one or more of these several uses. Snowplows and sweepers are often a composite vehicle, and in such cases must be counted only once, and with sprinklers should be reported under "Miscellaneous."

INQUIRIES 8 AND 9.—POWER-PLANT EQUIPMENT AND ELECTRICAL GENERATORS.

The capacity of the engines and water wheels and of the dynamos is closely related. The engines and water wheels, as a rule, have an excess capacity over that of the dynamos.

The answer to Inquiry 8 must show the total number and indicated horsepower of each of the four classes of machines distributed by the four classes specified. The horsepower given must in every instance be the total for all the machines reported for each class shown. If the company operates more than one contributing power plant, include the total for all.

The answer to Inquiry 9 must show the total number and kilowatt capacity of each of the three classes of dynamos. The kilowatt capacity given must in every instance be the total for all machines reported for each class shown.

INQUIRY 10.—OUTPUT OF STATION AND CURRENT PURCHASED.

This is an inquiry in regard to which some roads may have no data, although with many of them it is a matter of careful scientific accounting. In every case the volts multiplied by the amperes will give the number of watts. A kilowatt is 1,000 watts. There are 746 watts in the old familiar horsepower, so that a kilowatt is, roughly, $1\frac{1}{3}$ horsepower. Watt hours are the product of watts multiplied by the number of hours during which the current is in use. Thus a power house with a dynamo delivering current to the line of 1,000 amperes at 550 volts pressure is generating 550,000 watts, or 550 kilowatts. If these 550,000 watts are furnished, on an average, 20 hours daily, we get 11,000,000 watt hours, or 11,000 kilowatt hours. The total for the year can be arrived at from the daily totals.

INQUIRY 11.—SUBSTATION EQUIPMENT.

Substation equipment is particularly a feature of long-distance rural electric-railway work. Such equipment is, however, frequently included in the main power plant. The total number and total kilowatt capacity for all machines in the main power plant and in all separate substations operated by the company must be reported for each of the five classes of machines specified, and also the total number and capacity for all other miscellaneous machines of this general class. Storage batteries are used, either in the main power plants or in the substations, to help maintain a steady supply of current at the right pressure, and "boosters" are dynamos assisting to the same end.

The feature of substation equipment is that, as a rule, it does not generate current, but receives it, manipulates it, stores it, and lowers the pressure or changes the form for local consumption.

INQUIRY 12.—TRAFFIC AND MILEAGE.

Transfer passengers carried.—Many street railway voluntarily, or when required by law, give free transfers to passengers paying one fare and desiring to ride over more than one line. These transfers are generally issued in the shape of tickets at junction transfer points, or sometimes the passenger steps from one car to the other, without such a ticket, under the eye of the transfer agent, and in this manner a continuous ride can be made over more than one road for the one fare. Careful count or estimate of transfers is made by all the roads granting them. Transfers for which an extra charge is made should be counted as revenue passengers.

Free passengers carried.—All free passengers carried should be reported here. This includes employees of the company and local government and other persons riding on passes. If there is no record, give a careful estimate, as indicated by the inquiry.

Car mileage.—It is an ordinary practice for street railways to keep an account of this mileage. Where it is not known, the car mileage can be estimated fairly well by ascertaining the number of round trips daily on each line or branch of the system and multiplying this by the length of the respective trips. The daily average should be multiplied by the number of days the road was in operation during the year to obtain the total for the period covered by the report. The number of miles that cars run per day depends upon the location of the road, roads in rural districts making faster time than those in cities.

The use of "trailers" is a source of confusion in computing the car mileage. As a rule the individual car should be considered as the unit in computing the car mileage; but when it is the practice of the company to consider the motor car and the trailer as one car in making the computation, the company's figures should be accepted. Train mileage based on three or more cars should not be accepted for car mileage.

The ratio of the number of fare passengers to the number of car miles run has a very important bearing upon the prosperity of the street railway business. For the country as a whole the average number of fare passengers per car mile in 1907 was 4.70. The cars were run, therefore, on an average, a little more than one-fifth of a mile for each fare collected. An extreme variation from this average should be questioned, and if correct, fully explained on the last page of the schedule.

In many cases the car mileage of express, freight, mail, and work-car service will be a matter of estimate and should include mileage of steam or electric locomotives.

The other inquiry, "car hours," is a comparatively new method of accounting for car operation and is employed by a large number of roads.

The car hour represents the time the cars are out of the barns in service, and includes all time they are held by blockades or other causes. It is based upon the principle that but little of the operating expense can be stopped or even checked when a day has started, and that if most of the cars are blocked the expense in large degree will be continued even though the earnings may wholly cease.

The revenue passengers per mile of track, car mile, and car hour must be computed and submitted to the person furnishing the data to see that they harmonize with the same computations that have been made for the use of the company in its financial reports.

Fare charged per passenger within city limits.—The object of this inquiry is to obtain a statement of the fare charged for a continuous ride within the city limits of each city in which the company operates, and the variations in this fare. In some instances lower fares are charged for school children or during the rush hours of morning and evening, and tickets are sold at a slight reduction from the single-fare rate. All of these facts must be clearly stated, together with the actual amounts paid for the continuous ride in each case.

Inquiries 13, 14, and 15 conform with the system of accounting adopted by the Interstate Commerce Commission, and the marginal numbers correspond with the numbers given in the official classification.

INQUIRY 13.—REVENUE AND INCOME ACCOUNT.

Give the actual amounts carried on the revenue and income account statement of the company. This may in some cases include bookkeeping items of income and expenses for the year, and therefore need not in every instance agree with an actual cash statement for the year.

Passenger revenue.—Include cash fares, sale of tickets and commutation books, and all sources of income from passengers.

Parlor, chair, and special car revenue.—It is a practice of many street railways to hire out cars for special travel purposes. These are usually known as "special" cars, a definition which includes theater cars, funeral cars, or other cars furnished for private use under special arrangement. For all work of this class it is the custom to make a special and separate rate, and the roads doing this business should have no difficulty in giving the income from it. Parlor-car and chair-car revenue should include the revenue from extra accommodations in cars of special types.

Freight, mail, express, baggage, and milk revenue.—Some electric interurban roads carry large quantities of freight and express matter. If it is impossible to ascertain the exact amount of each class of income, obtain the total for all items combined and prepare a careful estimate for each of the several items.

Sale of electric current.—Be careful to include the income from the sale of current to other public service corporations. If a combined report is prepared for railway and light and power plant, the total income reported in Inquiry 18 should also be reported in answer to this question.

Interest on bonds and dividends on stock of other electric railways.—It is necessary to show the total net amount of interest on funded debt and of dividends paid by street railway companies to the outside public as distinguished from the gross interest and dividends, part of which goes to other street or electric railways. For this purpose the income from interest on bonds of other street or electric railway companies and the amount received as dividends on their stocks must be reported in answer to this question.

Income from other permanent investments.—Railway companies may own securities of public service corporations other than electric railways, also industrial or municipal securities. It is desired to secure a separate statement of the income, if any, from such sources.

Other miscellaneous income.—This item should include all amounts received from sources other than those enumerated, such as income from interest on deposits, outside operations of the company, etc. The principal items must be enumerated separately. The total income reported must be the gross income of the company for the year.

Taxes.—The sum of all taxes for the year should be reported. Include special taxes, such as car licenses, special taxes for police service at street crossings, etc., but in such cases a note must be made on the schedule describing the tax or license. Give separate amounts, by estimate, if necessary, for each of the five subdivisions of the inquiry.

Interest on funded and floating debt and mortgages.—When funded debt is shown as a liability in answer to Inquiry 15, interest should be reported as accrued on funded debt or proper explanation made on the last page of the schedule. In like manner if real estate mortgages and floating debt are shown as a liability under Inquiry 15, interest should be reported or explanation made.

INQUIRY 14.—OPERATING EXPENSES.

Substantially the same form of accounting for operating expenses is now used by all electric railways. This form was devised by the American Electric Railway Accountants' Association, and with some slight modification was adopted by the United States Interstate Commerce Commission. It is used by the railway commissions in the majority of the states. This form of accounting is in such general use that it is not necessary to give detailed instructions concerning the various items to be included under each of the five general groups of expenses for which separate totals are required. The primary accounts, as prescribed in the classification of operating expenses of electric railways adopted by the Interstate Commerce Commission, are arranged for three classes of companies, as follows:

Class A.—All companies with annual operating revenues of more than $1,000,000.

Class B.—All companies with annual operating revenues of more than $250,000, but not in excess of $1,000,000.

Class C.—All companies with annual operating revenues of not more than $250,000.

The form of accounting for class C companies is the simplest form used by the Interstate Commerce Commission, and this form has been adopted for the census.

The marginal numbers are account numbers of the Interstate Commerce Commission used in their most detailed form of accounts, which is required of the class A companies. For example, under "Ways and structures" numbers 2 to 19 represent all of the separate accounts in the form for class A companies that can properly be considered as expense of "Maintenance of way."

Accounts 20 to 24 include all that can be considered as expenses of "Maintenance of electric lines." These combinations have been made so it will be more convenient to prepare the reports for companies that do not keep accounts with all of the detail provided by the extended form. The inquiry contains five subtotals. In compiling the statistics the greatest use will be made of these subtotals. Therefore it is essential that each of these totals contain amounts for all items properly chargeable to it, and also that none of the amounts are duplicated.

INQUIRY 15.—BALANCE SHEET.

This condensed statement must balance and show the financial condition of the company on December 31, 1912, or the last day of the year for which the report is made. Any large items which would come under the head of "Sundries" should be stated specifically.

The combined balance sheets of all roads in the country must result in showing the total capital stock and funded debt of both operating and leased roads. Therefore the proportion of these securities which are owned by street or electric railways should be shown separately, so that a net figure for each kind of capital can be presented. For this purpose it is necessary that the amount of stocks of other street or electric railway companies and the amount of bonds of other street or electric railway companies owned by the company reporting must be reported in answer to the second question under "Assets."

If there is a profit and loss *deficit*, or if a large amount is reported for "other permanent investments," the reason for the loss and the nature of the investments should be given on the last page of the schedule. Items such as "purchase of completed road" or "payment for franchise" may be included as "cost of construction, equipment, and real estate," and not as "sundries" or "other permanent investments." "Sundries" is intended to include only the minor elements of accounts.

INQUIRY 16.—EMPLOYEES, SALARIES, AND WAGES.

The salaries and wages reported here will also be included in the amounts reported for the different items, under Inquiry 14, "Operating expenses," but this statement is required in order to obtain the number and wages for each class of employees. Account for all persons employed by the company, both in the management and in the operation of the road. Give the number of officers who receive salaries (not the number of stockholders) and the total amount of their salaries. Report separately the number and wages of conductors, motormen, and all other employees. If possible, the number employed on September 16, 1912, should be reported, as it is desirable to have the figures represent the same day for all companies. There should be no difficulty in securing this information, as all companies have a record of some character concerning their employees. If the road was in operation only a portion of the year, and for this or other reason the number can not be obtained for September 16, obtain the number for the nearest representative day.

The salaries and wages must be the total amounts paid during the year or period covered by the report.

INQUIRIES 17, 18, AND 19.—QUESTIONS FOR RAILWAYS WHICH OPERATE SEPARATE ELECTRIC LIGHT AND POWER PLANTS.

These inquiries, when considered in connection with their accompanying instructions and those at the top of page 2 of the schedule and page 13 of these instructions, should be readily understood and properly answered.

SEPARATE REPORTS FOR NONOPERATING AND LESSOR ELECTRIC RAILWAY COMPANIES MUST BE MADE ON SPECIAL SCHEDULE THEREFOR.

Separate reports must be obtained for all street railways which are leased to operating companies, covering the data for length of track, the income account, and balance sheet. The purpose is to present, in the financial accounts, a correct bookkeeping total of income expenses, etc., including the duplications which arise from the practice of leasing railway properties. The amount of such duplications will then appear under the respective inquiries in the schedules, and net amounts can be calculated.

Aside from the desirability of having such complete bookkeeping accounts it is essential to secure the statistics of leased roads separately in order to avoid error.

While agents may be able to prepare correct reports for the operating companies so far as the physical equipment and traffic features are concerned, it is very difficult to make a proper consolidation of the financial items. It requires an expert accountant to combine correctly figures of leased and operating roads, avoiding duplication.

While the figures for both operating and leased roads should be published separately, it will not do to calculate either the cost per mile of track or the capital liabilities per mile of track of either the operating or the leased roads separately, since in many cases the operating company spends large sums in improving leased lines which are not counted in the cost of such leased lines.

When the attempt is made to combine reports of operating and leased roads there should be an item of receipt in the revenue and income account, usually in the form of payments of guaranteed dividends and interest on stock and bonds received by the leased companies, equal in amount to the item for rentals paid under the heading of "Expenses" by the operating companies. The net income would then include the amount of rentals as well as the dividends and surplus of the operating company. Indeed, if the operating company and leased lines were to be treated strictly as one, both payments for rentals and receipts from rentals would be omitted. When separate reports of operating and leased companies are made and tabulated, rentals received in the totals will balance rentals paid, and total net income will include the dividends and surplus of both operating and leased companies, or the real profits of the business.

In the same way the item of interest on funded debt in the case of operating companies should include only interest on their own bonds. In many cases such companies assume directly the bonds of leased lines. The schedule should show the interest of the operating companies on their own debt and that on the debt of leased lines, but only the former must be charged as interest and the latter as "rent of leased lines and terminals." The rental received by leased companies will then be made to show the sum intended for interest on other bonds, and their expenditures will show a payment for such interest.

Operating companies often own part of the securities of leased companies. A correctly combined balance sheet of both operating and leased companies will show the total capital stock and funded debt of both, and over against this, under the head "Stocks and bonds of other electric railway companies," the amount of stocks and bonds held by the operating company.

Because of the complications above indicated it is evidently essential to correctness of data, and for the purpose of securing a net balance sheet, *to insist on having separate* supplementary reports for nonoperating and lessor companies.

There are comparatively few leased street railways, and the supplementary figures desired can be obtained with little difficulty. Reports for leased roads should accompany the report of the operating company.

Reports should also be prepared on this form for "Holding companies." These companies hold the capital stock of street railway companies. Inquiries 2 and 3 should be answered.

ELECTRIC LIGHT AND POWER STATIONS.

Reports must be secured for all electric plants doing a public service business—that is, for all plants, whether owned or operated by individuals, firms, corporations, or municipalities, established for the purpose of generating electric current for sale that were in existence during any portion of the year ending December 31, 1912.

No report is required for isolated electric light or power plants operated primarily for the benefit of the owner in lighting and furnishing power for his factory, hotel, or other enterprise, even though some current may be sold. The instructions on the title-page of the schedule provide that "isolated plants which incidentally sell current must be reported." This was intended for the guidance of persons who would receive the blank schedule through the mail and to avoid the possibility of omitting any central stations. Such plants can not be considered as central stations, and agents must not secure reports for them.

Electric plants owned by the United States and state governments and operated primarily for supplying light or power to public buildings, military posts, naval stations, Indian reservations, etc., should be considered isolated plants operating for their own benefit and no report secured.

Combined reports.—If the electric plant is operated in connection with an electric railway, separate reports should, if possible, be prepared, as required by the instructions on page 2 of the schedule.

If the electric plant is operated in connection with any business other than a street railway, and the system of accounts will not permit of the preparation of a separate return, careful estimates must be prepared for answer to all the questions contained in the schedule. These estimates must pertain *only* to the electric light and power station, and be prepared by, or submitted to and approved by, the person furnishing the information and that fact indicated under "Remarks" on the last page of the schedule.

Where two or more plants are owned by one individual, firm, or corporation, and located in the same city or town, one combined report may be secured. In such cases the number of separate plants included in the report, and their names and locations, should be stated in answer to Inquiry 2. Light and power plants operated by the same corporation, firm, or individual, and located in different states, counties, cities, or towns, should be reported separately.

INQUIRY 5.—NUMBER OF LAMPS.

The answers to this inquiry must show the total number of the different varieties of lamps connected or wired ready for service on December 31, 1912, or the last day of the period covered by the report, and not the number actually performing service at any one time. The total must include all lamps in position to earn an income, irrespective of their ownership. Therefore it may include many lamps that are *not owned* by the company. If there is no record of the actual number of lamps, secure a careful estimate. The distinction between "Street lighting," the lighting of "Public buildings," and "Commercial or private lighting" must be carefully preserved.

Arc electric lamps are usually employed in street lighting, and are those having either one or two pairs of carbons inclosed in a single large globe. An inclosed arc lamp has two globes, a large or outer one inclosing a small one in which a single pair of carbons is incased, and is designed to burn a large number of hours (one hundred to one hundred and fifty) before having the carbons renewed. No distinction, however, is desired as to the particular kind of arc lamps used.

INQUIRY 6.—MISCELLANEOUS STATISTICS.

Stationary motors.—This term is applied by central station men to electric motors that are permanently located in one place, as distinguished from electric railway motors on cars. Such stationary motors will cover an infinite variety of work, and in many cases the companies will have difficulty in reporting the number of motors on their circuits, especially where current is furnished through meters. Where exact figures can not be given from records it is desirable that a close estimate be secured. The field covered by these stationary motors will include every class of industrial work and many other methods of application, such as in running large ventilating fans, elevators, etc. It is a custom of many companies to make special rates for what they call "power" business, as distinct from that done in supplying current for lamps; and where this is the case, their records should show the data as to motor service and income.

Recording meters on consumption circuits.—This inquiry applies solely to the number of electric meters installed on the consumers' premises, just as gas meters are placed for recording gas consumption, and does not apply to meters installed at the central station.

INQUIRIES 7, 8, 9, AND 10.—POWER-PLANT EQUIPMENT, ELECTRICAL GENERATORS, OUTPUT OF STATION, AND SUBSTATION EQUIPMENT.

See instructions for Inquiries 8, 9, 10, and 11 concerning street railways on pages 9 and 10.

INQUIRY 9.—OUTPUT OF STATION.

In addition to the instructions for Inquiry 10 of the schedule for electric railways, attention is called to the following: The kilowatt hours may be tested by the earnings, as reported in Inquiry 11, and estimated value of free service, as reported in Inquiry 12. The average varies considerably for individual plants, but if the average is less than 1 cent or more than 15 cents per kilowatt hour the figures should be questioned, and if found correct, explanation made under "Remarks" on the last page of the schedule.

A standard arc lamp consumes from 450 to 550 watts per hour; ordinary carbon filament incandescent lamps of 16 candlepower have an average consumption per hour of about 3.1 watts per candlepower. Many incandescent lamps now in use, like the tantalum and tungsten, take much less.

In all calculations of average earnings per kilowatt hour and consumption of current per lamp, etc., the loss of current in transmission must be considered.

Inquiry 11.—Revenue and income account.

The instructions on the schedule and those for the coresponding inquiry (No. 13) of the electric railway schedule are sufficient to enable a proper understanding of this inquiry. The following points, however, should be emphasized:

The revenue and expenses must cover the financial transactions of the entire system covered by the report for the year to which it relates.

The amounts must be only those incident to the operation and maintenance of the plant or plants covered by the report.

Do not include expenditures for additions or extensions.

Do not include estimated income for free service, but report this as called for under Inquiry 12 only.

As only the profit on merchandise sales is to be reported as an income, the expense for supplies should *not* include those purchased for sale.

The expenses for taxes and interest must include all amounts properly chargeable to these accounts.

Central electric stations are frequently operated in connection with the manufacture of gas or ice, the operation of waterworks or commercial enterprises. In such cases the income, expenses, and balance sheet should relate only to the operation of the electric plant and careful estimates should be given if accurate figures can not be obtained from book accounts. However, if the other industry is merely incidental to the operation of the electric plant the report may cover both. In such cases the income from the outside industry should be included in the total reported for "All other income, including rents and profits on merchandise sales."

Inquiry 12.—Free service.

Practically all of the central stations owned and operated by municipalities receive no income from current furnished for the use of the cities. A number of the commercial stations also furnish current to municipalities or other governments free of charge. The estimated value of the current thus furnished free to municipalities or other governments, based upon the prevailing commercial rates, should be reported only in answer to this inquiry.

Inquiries 13 and 14.—Employees, salaries and wages, and balance sheet.

See instructions for Inquiries 15 and 16 concerning electric railways on pages 15 and 16.

MUNICIPAL PLANTS.

The schedule for electric light and power stations is prepared primarily for plants owned by individuals, firms, or corporations. In applying this schedule to plants owned and operated by municipalities certain changes will be necessary. These changes should be made by the agent, and additional information, when required, must be given under "Remarks" on the last page of the schedule.

It will often occur that the administration of a municipal plant is assigned to a public officer or officers performing other duties, or that a part or all of the labor of collecting and accounting is done in the office of some other department—waterworks, for example. If in these cases a general account is kept for two or more departments, such as water, streets, etc., the expenses for the electric plant should be apportioned equitably. The following plan is suggested to aid in arriving at an equitable apportionment of the salaries, wages, miscellaneous expenses, etc.: For officers, clerks, and all employees, charge to each service the same proportion of the total amount paid in salaries or wages as the time devoted to that service constitutes of the whole time worked; for rent and all sundry office expenses, charge in proportion to the income of each service; for insurance, taxes, law expenses, interest, and all contingent expenses, in proportion to the amount of investment; for fuel, water, and all other power expenses, in proportion to the horsepower utilized by each service.

Inquiry 11—Revenue and income account.—As shown by the instructions on the schedule, the income for municipal plants must include only the actual amounts carried on income-account statement.

An estimate of the value of the service to the city, based on prevailing commercial rates, must be given in answer to Inquiry 12.

Inquiry 14—Balance sheet.—The portion of the inquiry relative to capital stock and dividends is not applicable to municipal plants. As a rule, there is a special bond issue to cover the installation of the electric plant. The amount of such bonds authorized by the special act and the amount outstanding at the end of the year, together with the interest paid or due for the year, should be reported. If, however, there was no special issue of bonds, the cost of the electric plant being met by proceeds of a general bond issue or special tax fund, a full explanation of the arrangement and a description of the general bond issue or special tax should be given under "Remarks."

INDEX.

CENTRAL ELECTRIC LIGHT AND POWER STATIONS.

[For Index to Street and Electric Railways, see p. 437.]

Agriculture, use of electricity in, 154.
Alabama. *See* States.
Arc lamps, number of, for central stations, 17, 57, 59, 107; for commercial stations, 17, 108; for municipal stations, 17, 109; relation to population, 19; for electric railways, 56; average per station, 58; for street lighting, 59, 107–109; for public buildings, 107–109; development of, 137.
Arizona. *See* States.
Arkansas. *See* States.
Assets, amount of, 70; for commercial stations, 72; for municipal stations, 74.

Bakeries, use of electric ovens in, 160.
Baltimore, Md., average rate for central station service, 170.
Boilers, types of, 115.
Boosters, number and kilowatt capacity of, for central stations and electric railways (combined), 61; for central stations, 104; for commercial stations, 105; for municipal stations, 106.
Boston, Mass., average rate for central station service, 170.
Buffalo, N. Y., average rate for central station service, 170.

California. *See* States.
Capital stock, amount of, for commercial stations, 63, 64, 73.
Capitalization, amount of, for electrical industries, 11; for central stations, 63; for commercial stations, 63, 64; for municipal stations, 63.
Cash investments, amount of, for commercial stations, 63, 73; for municipal stations, 75.
Central stations, summary of statistics, 11, 17, 20, 82; number of, 15, 48; output of, 19, 84; comparison with gas plants, 18; relation of leading items to population, 19; primary power machines, 28, 98; number reporting water power of 1,000 horsepower and over, 36; dynamo capacity, 43, 46, 48, 69; output of generating stations, 49, 50, 104; purchased current, 52; line equipment, 56–58, 107; stationary motors, 60; subsidiary equipment, 61, 104; capitalization, 63; cost of construction and equipment, 65; income, 67, 69, 88; expenses, 69, 92; employees, salaries, and wages, 76, 77, 79; consolidation of, 111; relation to electric railways, 113; use of storage batteries, 137; average rates for service, 170.
  See also Commercial stations *and* Municipal stations.
Central stations and electric railways (combined), primary power, dynamo capacity, and output of, 53, 54.
Chicago, Ill., average rate for central station service, 170.
Cincinnati, Ohio, average rate for central station service, 170.
Clerks, stenographers, and other salaried employees, number and salaries of, for central stations, 76, 79.
Cleveland, Ohio, average rate for central station service, 170.
Coal, facilities for obtaining, 115; storage of, 118.
Colorado. *See* States.
Combustion tests, types of boilers used in, 116.
Commercial light, power, and heat, income from, for central stations, 88; for commercial stations, 89; for municipal stations, 90.
Commercial stations, use of term, 15; comparison with municipal stations, 17; number of, 19, 21, 66; summary, 21; ownership of, 21; per cent of total stations, 22; purely electric and composite, 26; primary power machines, 30, 100; kinds of primary power 31; average horsepower, 31; steam engines and steam turbines, 32; water wheels and turbines, 35; gas and oil engines, 42; dynamos, 44, 45; number reporting no generating equipment, 49; output of generating stations, 49, 105; line equipment, 57, 58, 108; street lighting, 59; subsidiary equipment, 61, 105; capitalization, 63; capital stock, funded debt, and dividends, 64; cost of construction and equipment, 66; income from service, 67, 88, 89; expenses, 70, 94; balance sheet, 72; employees, salaries, and wages, 76; estimated value of free service, 88.
Common stock of commercial stations, 63, 64, 73.
Composite stations, use of term, 15, 25; commercial and municipal, 26.
Connecticut. *See* States.
Construction and equipment, cost of, for gas plants, 18; for central stations, 18, 65, 66; for municipal stations, 63, 66; for commercial stations, 66.
Cooking, electric, cost of, 159; rates in force, 167.
Cotton ginning, capacity of machines, 147.
Counties Gas & Electric Co. (Norristown and Conshohocken, Pa.), rate schedule of, 171.
Curing meats, use of electricity in, 160.
Customers, number furnished electric current for central stations, 57, 82, 107; for commercial stations, 108; for municipal stations, 109.

Damages. *See* Injuries, etc.
Delaware. *See* States.
Denver, Colo., average rate for central station service, 171.
Depreciation, charges for, for central stations, 93; for commercial stations, 95; for municipal stations, 96.
District of Columbia. *See* States.
Dividends, amount of, on common and preferred stock, for commercial companies, 64; amount due, 73.
Dynamos, kilowatt capacity of, for central stations, 17, 19, 46, 66, 83; relation to population, 19; number and capacity of, for central stations, 43, 45, 104; for commercial stations, 105; for municipal stations, 106.

Egg incubators, capacity of, 156.
Electric and waterworks department (Marshall, Mich.), rate schedule of, 176.
Electric current and electric power purchased, cost of, for central stations, 92, 147; for commercial stations, 94; for municipal stations, 96.
Electric railways, central station work of, 18; primary power machines, 28; dynamo equipment, 43; output of generating stations, 49; purchased current, 52; line equipment, 56; subsidiary equipment, 61; relation to central stations, 113.
Electric service, income from, for central stations, 67, 69, 82, 88; for commercial stations, 89; for municipal stations, 90.
Employees, number of, for electrical industries, 11; for central stations, 17, 18, 76, 77, 79, 82; for commercial stations, 17, 76; for municipal stations, 17, 76; for gas plants, 18; salaries and wages, amount of, for electrical industries, 11; for central stations, 76, 77, 79.
Engines and water wheels, horsepower of, 19.
Equipment. *See* Construction, etc.
Evansville Public Service Co. (Evansville, Ind.), rate schedule of, 173.
Expenses, amount of, for electrical industries, 11; for central stations, 17, 69, 70, 82, 92; for commercial stations, 17, 94; for municipal stations, 17, 96.

Fire department, use of electric vehicles by, 158.
Flatbush Gas Co. (Brooklyn, N. Y.), rate schedule of, 175.
Floating debt, amount of, for commercial stations, 63, 73; for municipal stations, 75.
Florida. *See* States.
Flour milling, capacity of electric motors, 149.
Fuel, cost of, for central stations, 69, 92; for commercial stations, 94; for municipal stations, 96; use of gas and oil as, 119.
Funded debt, amount of, for commercial stations, 63, 64, 73; for municipal stations, 75.

Gas and oil engines, number and horsepower of, for central stations, 17, 28, 30, 42, 83, 99; for electric railways, 28; for central stations and electric railways (combined), 54; for commercial stations, 101; for municipal stations, 103; increase in use of, 120.
Gas plants, comparison with central stations, 121; use of lignite coal in, 121.
Generating stations, output of, for electric railways, 49; for central stations, 49, 50, 104; for commercial stations, 105; for municipal stations, 106.
Generators, auxiliary, number and capacity of, for central stations, 104; for commercial stations, 105; for municipal stations, 106.
Geographic divisions, relation of leading items to population by, 19; municipal stations, 22, 23; hydroelectric stations, 38; dynamo capacity, 46, 48, 54; stations having no generating equipment, 49; output of stations, 50, 54, 78, 104, 105; purchased current, 52; primary power, 54, 98, 100, 102; lamps for street lighting, 59; cost of construction and equipment, 65; balance sheet, 72, 74; comparative summary, 82; employees, salaries, and wages, 77, 79; income, 88–90; expenses, 92, 94, 96; line equipment and number of customers, 107–109.

Georgia. *See* States.
Green Bay Gas & Electric Co. (Green Bay, Wis.), rate schedule of, 171.

Hartford Electric Light Co. (Hartford, Conn.), rate schedule of, 175.
Heating, electric, advance in perfection of apparatus used in, 159; rates in force, 167.
"Holding" companies, creation of, 112.
Hydroelectric stations, use of term, 35; number reporting water power of 1,000 horsepower or more, 38.

Ice manufacture, number of plants operated from central stations, 151.
Idaho. *See* States.
Illinois. *See* States.
Incandescent lamps, number of, for central stations, 17, 57, 59, 107; for commercial stations, 17, 108; for municipal stations, 17, 109; relation to population, 19; for electric railways, 56; average per station, 58; for street lighting, 59, 141; display illumination, 145.
Income, amount of, for electrical industries, 11; for central stations, 17, 18, 67, 69, 82, 88; for commercial stations, 17, 67, 89; for municipal stations, 17, 67, 90; for gas plants, 18.
Indiana. *See* States.
Injuries and damages, expenses of, for central stations, 69, 93; for commercial stations, 95; for municipal stations, 96.
Insurance, amount of, for central stations, 69, 93; for commercial stations, 95; for municipal stations, 96.
Interest, on funded and floating debt, for central stations, 69, 93.
Investments, interest and dividends from, for central stations, 88; for commercial stations, 89; for municipal stations, 90.
Iowa. *See* States.
Irrigation, installation of motor-operated pumps for use in, 155.
Isolated stations. number and magnitude of, 17.

Kansas. *See* States.
Kansas City, Mo., average rate for central station service, 171.
Kentucky. *See* States.

Lamps wired for service, arc, incandescent, and other varieties, number of, for central stations, 17, 56, 83; for commercial stations, 17, 108; for municipal stations, 17, 109.
Liabilities, amount of, 71; for commercial stations, 73; for municipal stations, 75.
Light and Power Commission (Marquette, Mich.), rate schedule of, 176.
Lignite, utilization of in central stations, 116.
Line equipment, for central stations and electric railways (combined), 56; for central stations, 57, 58, 107; for commercial stations, 57, 108; for municipal stations, 57, 109.
Louisiana. *See* States.

Madison Gas and Electric Co. (Madison, Wis.), rate schedule of, 172.
Maine. *See* States.
Managers. *See* Superintendents, etc.
Maryland. *See* States.
Massachusetts. *See* States.
"Mazda" lamp, adoption of, for street lighting, 144.
Meters on consumption circuits, number of, for central stations, 56, 57, 82, 107; for commercial stations, 57, 108; for municipal stations, 57, 109; average per station, 58.
Michigan. *See* States.
Minnesota. *See* States.
Mississippi. *See* States.
Mississippi River Power Co., electrical development of plants, 123.
Missouri. *See* States.
Montana. *See* States.
Motor generator sets. *See* Rotary converters, etc.
Municipal building lighting, income from, for central stations, 88; for commercial stations, 89; for municipal stations, 90.
Municipal stations, use of term, 15; comparison with commercial stations, 17; number of, 19, 66; per cent of total stations, 22; by population groups of cities, 23; purely electric and composite, 26; primary power machines, 30, 102; kinds of primary power, 31; average horsepower, 31; steam engines and steam turbines, 32; water wheels and turbines, 35; gas and oil engines, 42; dynamos, 44, 45; number reporting no generating equipment, 49; output of stations, 49, 106; line equipment, 57, 58, 109; street lighting, 59; subsidiary equipment, 61, 106; capitalization, 63; cost of construction and equipment, 63, 66; income from service, 67, 88–90; expenses, 70, 96; balance sheet, 71, 74; employees, salaries, and wages, 76; estimated value of free service, 88, 90.
Municipal street lighting, income from, for central stations, 88; for commercial stations, 89; for municipal stations, 90.

Natural gas, location of stations, 121.
Nebraska. *See* States.
Neon tube, description of lighting by, 147.
Nernst, vapor, etc., lamps, number of, for central stations and electric railways, 56; for central stations, 57.
Nevada. *See* States.
New Glaurus Municipal Electric Light and Water Plant (New Glaurus, Wis.), rate schedule of, 175.
New Hampshire. *See* States.
New Jersey. *See* States.
New Mexico. *See* States.
New York. *See* States.
New York, N. Y., average rate for central station service, 170.
North Carolina. *See* States.
North Dakota. *See* States.

Officers of corporations, number and salaries, for central stations, 76, 79.
Ohio. *See* States.
Oil engines. *See* Gas, etc., engines.
Oklahoma. *See* States.
Omaha Electric Light & Power Co. (Omaha, Nebr.), rate schedule of, 171.
Oregon. *See* States.
Outdoor substations, development of, 135.
Output of stations, kilowatt hours, for central stations, 17, 19, 104, 105; for commercial stations, 17, 105; for municipal stations, 17, 106; for central stations and electric railways (combined), 54.

Pennsylvania. *See* States.
Pennsylvania Water Power Co., description of plants, 122.
Peoples' Incandescent Light Co. (Meadville, Pa.), rate schedule of, 173.
Philadelphia, Pa., average rate for central station service, 170.
Pittsfield Electric Co. (Pittsfield, Mass.), rate schedule of, 173.
Preferred stock, amount of, for commercial stations, 63, 64, 73.
Primary power machines, kinds of, 28, 30, 31; number and horsepower of, for central stations, 28, 30, 82, 98; for commercial stations, 100; for municipal stations, 102.
Public buildings, lamps wired for, for central stations, 107; for commercial stations, 108; for municipal stations, 109.
Public utilities, general effect of regulation on, 163.
Pumps, capacity of, 148, 155.
"Purely electric" stations, use of term, 15, 25; commercial and municipal, 26.

Quartz lamp, greater concentration of energy by use of, 146.

Railways, supply and rates to, 169.
Rates, system of, 153, 161; discrimination in, 165; minimum charge, 166; for electric vehicles, 168; for railways, 169; average for central stations, 170; details of, 171.
Real estate mortgages, amount of, for commercial stations, 63, 73; for municipal stations, 75.
Rent of offices, etc., amount of, for central stations, 92; for commercial stations, 94; for municipal stations, 96.
Rhode Island. *See* States.
Rotary converters and motor generator sets, number and capacity of, for central stations and electric railways (combined), 61; for central stations, 104; for commercial stations, 105; for municipal stations, 106.

St. Louis, Mo., average rate for central station service, 171.
Salaries and wages, amount of, for electrical industries, 11; for central stations, 76, 77, 79.
Sewage disposal, use of electricity in, 150.
Signs, electric, universal use of, 145.
Sinking fund, charges for, for central stations, 93; for commercial stations, 95; for municipal stations, 96.
South Carolina. *See* States.
South Dakota. *See* States.
Southern California Edison Co., rate schedule of, 174.
States, list of, by geographic divisions, 25; primary power, 29, 30, 54, 98, 100, 102; steam power, 33; water power, 34; hydroelectric stations, 38; gas and oil engines, 42; dynamo capacity, 46, 47, 54; output of stations, 50, 51, 54, 104–106; purchased current, 52; lamps for street lighting, 59; cost of construction and equipment, 65; income, 68, 88–90; balance sheet, 72, 74; comparative summary, 82; employees, salaries, and wages, 77, 79; expenses, 92, 94, 96; generating and subsidiary equipment, 104–106; line equipment and number of customers, 107–109.
Stationary motors served, number and capacity of, for central stations, 17, 56, 57, 60, 83, 107; for commercial stations, 17, 108; for municipal stations, 17, 109; average per station, 58.
Stations. *See* Central stations, Commercial stations, *and* Municipal stations.
Steam engines, number and horsepower of, for electric railways, 28; for central stations, 28, 30, 32, 33, 98; for commercial stations, 100; for municipal stations, 102.
Steam engines and steam turbines (combined), number and horsepower of, for central stations, 17, 82; for central stations and electric railways (combined), 54. *See also* Steam turbines.
Steam heating, growth of industry, 152; decentralized plants, 154.
Steam power, tendency toward greater efficiency, 114; importance of central station work done by, 119.
Steam turbines, number and horsepower of, for electric railways, 28; for central stations, 28, 30, 32, 34, 99; for commercial stations, 101; for municipal stations, 103; size and power of, 115. *See also* Steam engines, etc.
Stenographers. *See* Clerks, etc.
Storage batteries, use of, by central stations, 137.

Street and electric railways, summary of statistics, 11.
Street lighting, lamps wired for, for central stations, 59, 107; for commercial stations, 108; for municipal stations, 109; improvement in, 141.
Street paving, change from steam power to electricty in, 150.
Subsidiary equipment, of central stations, 61, 104–106; of electric railways, 61.
Suction dredging, use of, in reclamation work, 149.
Superior Water, Light & Power Co. (Superior, Wis.), rate schedule of, 172.
Superintendents and managers, number and salaries of, for central stations, 76, 79.

Taxes, amount of, for central stations, 69, 93; for commercial stations, 95; for municipal stations, 96.
Telegraphs, summary of statistics, 11.
Telephones, summary of statistics, 11.
"Telpherage" systems, adoption of, 150.
Tennessee. *See* States.
Texas. *See* States.
Textile mills, operation of, 147.
Towers, construction and installation of, 134.
Transformers, number and kilowatt capacity of, for central stations and electric railways (combined), 61; for central stations, 104; for commercial stations, 105; for municipal stations, 106.
Transmission systems, operating at and above 70,000 volts, details of, 133.
Tungsten lamp, adoption of, for street lighting, 144.
Turbines. *See* Water wheels, etc., *and* Steam turbines.

United Illuminating Co. (Bridgeport, Conn.), rate schedule of, 174.
United States Reclamation Service, development work of, 133.
Utah. *See* States.
Utah Power & Light Co. (Idaho, Utah), rate schedule of, 174.

Vapor lamps, example of effectiveness of, 146. *See also* Nernst, etc., lamps.
Vehicles, electric, development of, 157; use of, by Government, 158; rates, 168.
Vermont. *See* States.
Virginia. *See* States.
Voltage, increase in, 133.

Wage earners, number and wages of, for central stations, 76, 79.
Wages. *See* Salaries, etc.
Washington. *See* States.
Washington, D. C., average rate for central station service, 170.
Water power, development of, 34, 122, 128; utilization of, 113; examples of high-head plants, 129.
Water wheels and turbines, number and horsepower of, for electric railways, 28; for central stations and electric railways (combined), 54; for central stations, 28, 30, 35, 83, 99; for commercial stations, 101; for municipal stations, 103.
Watertown Light & Power Co. (Watertown, N. Y.), rate schedule of, 173.
West Virginia. *See* States.
Wisconsin. *See* States.
Wisconsin Railway Commission, duties of, 162.
Wood-working plants, introduction of central station energy into, 150.
Wyoming. *See* States.

STREET AND ELECTRIC RAILWAYS.

Accounting, form of, 231.
Air brakes. *See* Brakes.
Alabama. *See* States.
All-steel cars. *See* Cars.
American Electric Railway Association, data as to fare boxes, 419.
Animal power. *See* Power.
Arizona. *See* States.
Arkansas, per cent increase in assets and liabilities, 267. *See also* States.
Articulated cars. *See* Cars.
Assets or liabilities, amount of, for operating and lessor companies, 264–266, 268, 323; for operating and lessor companies combined, 318; per cent distribution, 267.
Atchison (Kans.) Railway, Light & Power Co., superintendent quoted regarding one-man prepayment cars, 366.

Baggage, express, and milk business, companies reporting, 222, 258; income from, 222, 308.
Balance sheets, for operating and lessor companies, 264, 266; for operating and lessor companies combined, 268, 318, 322.
Baltimore & Ohio Railroad, pioneer user of heavy electric locomotives, 401.
Bay State Street Railway (Mass.), miles of line and track operated by, 188.
Belvidere (Ill.) City Railway, general manager quoted regarding one-man prepayment cars, 367.
Bonds, amount of, for operating and lessor companies combined, 322.
Boosters, number and kilowatt capacity of, 196, 280.
Boston, traffic density of roads, 215; fares in force, 416.
Boston Elevated Railway Co. (Mass.), miles of line and track operated by, 188; articulated cars in use by, 364.
Brakes, hand, cars equipped with, 210, 291.
——, air, increased use of, 397; cars equipped with, 398; recommendations concerning, 399.
Brooklyn Rapid Transit Co., center-entrance trolley car developed by, 379.
Buildings and structures, operating expenses of, 314.
Bull Run plant (Portland, Oreg.), electric equipment of, 338.
Butte, Anaconda & Pacific Railroad, features of electrification of, 403.
Cable power. *See* Power.
Cable roads, traffic of, 215.
California, electric track other than overhead trolley, 201; total trackage, 205; express, freight, mail, and baggage cars, 209; average gross income, 261; increase in assets and liabilities, 267; income accounts, 305, 306. *See also* States.
Cape Girardeau-Jackson (Mo.) Interurban Railway, general manager quoted regarding one-man prepayment cars, 366.
Capital stock, amount of, 186, 191, 264, 318; common and preferred, 299, 323.
Capital Traction Co., Washington, D. C., progress in steam-turbine development by, 328; opinion of company regarding fare boxes, 420.
Capitalization, comparative summary, 186; amount of, for operating and lessor companies, 190, 191, 223; for holding companies, 226; for operating and lessor companies combined, 229; for elevated and subway, and surface companies, 230; by states, 230, 299.
Car mileage, total, 186, 190, 293; per cent increase and per cent distribution, 214.
Car-hours, total number, 186, 293; companies reporting, 190, 293; traffic statistics, 217.
Cars, number and kind of, 186, 209, 288, 290; equipment, 209, 210, 288, 291; expenses of operation, 247, 311, 316; revenue from, 288, 290.
—— all-steel, description of, 363.
—— articulated, description of, 364.
—— center-entrance, types evolved, 375.
—— double-deck, cost and efficiency of, 359.
—— electric, track mileage of, 283.
—— express, freight, mail, and baggage, number of, 209, 288, 290.
—— express and interurban, examples of, 369.
—— funeral-trolley, types of, 370.
—— gas-electric, cost of operating, 374, 375.
—— gasoline, limited use of, 374.
—— parlor, chair, and special, revenue from, 308.
—— parlor, sleeping, dining, and private, number of, 209.
—— passenger, number of, 182, 184, 209, 212, 288, 290; revenue from, 308.
—— prepayment, number of, 209; one-man, statements regarding, 365; fares, 418.
—— service (work cars, snowplows, sweepers, etc.), number of, 209, 288, 291.
Cars, storage battery, adoption of, 371.
—— and locomotives, expense of maintenance of electric equipment of, 315.
Cash and current assets, including supplies, amount of, for operating and lessor companies combined, 322.
Center-entrance cars. *See* Cars.
Central electric stations, power statistics for, 183.
Chicago, traffic density of roads, 215; new street-car types, 360; fares in force, 415.
Chicago, Milwaukee & Puget Sound Railway, plans for electrification of, 349.
Chicago Elevated Railways, description of all-steel cars in use by, 363.
Chicago Railways Co. (Ill.), miles of line and track operated by, 188.
Cities, rates of fare within limits of, 218.
City and suburban lines, track mileage of, 200, 283.
Clerks, stenographers, and other salaried employees, number and salaries of, 269, 270, 325.
Cleveland, Painesville & Eastern Railroad, interurban light and railway plant operated by, 333.
Cleveland (Ohio) Railway Co., addition of center-entrance cars to equipment, 375.
Colorado, express, freight, mail, and baggage cars, 209. *See also* States.
Columbus, Ohio, use of stepless double-deck cars in, 359.
Companies, number of, 182, 186; increase in size of, 187; classified according to miles of line, 188; according to kind of power, 195, 198; with power plant equipment, 196; power and output of stations, 198; using power other than electric, 205; "elevated and subway," and "surface," 212; traffic, 216; capitalization, 223, 299; income and deficit, 234; with income from sale of current, 239; without and with commercial lighting, 243, 257; interest, 255; general results of operations, 257; doing freight, mail, express, etc., business, 258; operating ratios, 262; reporting surplus balances and deficit balances, 265; balance sheet, 266; with light and power departments, 275; revenue car hours, 293. *See also* Lessor companies, Nonoperating or lessor companies, Operating companies, *and* Operating and lessor companies combined.

Companies with power plant equipment, number of, 278.
Concrete poles. *See* Poles.
Conductors, number and wages of, 269, 270, 325.
Conductors, motormen, and trainmen, operating expenses of, 316.
Conduit system, track mileage of, 200, 201.
Connecticut, electric track other than overhead trolley, 201. *See also* States.
Connecticut Co. (Conn.), miles of line and track operated by, 188; methods of paving, 387.
Construction and equipment, cost of, for operating and lessor companies, 182, 264; for operating and lessor companies combined, 182, 184, 264, 318, 322.
Current, generated and purchased, 186, 280; revenue from sale of, 275, 308.

Damages. *See* Injuries, etc.
"Dan Patch" line, cost of operating gas-electric motor cars by, 374.
Debt, amount of, for operating and lessor companies combined, 266.
Deficit, companies reporting, 234.
Delaware, miles of track other than overhead trolley, 201. *See also* States.
Detroit United Railway Co., one-man prepayment car operated by, 365.
Dispatching. *See* Signaling, etc.
District of Columbia, miles of track other than overhead trolley, 201. *See also* States.
Dividends, amount of, for operating companies, 186, 302; for lessor companies, 186; analysis of, 228; for operating and lessor companies combined, 307; common and preferred, 299; for nonoperating or lessor companies, 305.
Double-deck cars. *See* Cars.
Dynamos, kilowatt capacity of, 183, 186, 196, 280, 343; number of, 196, 280.

Electric lines, expenses of maintenance of, 314.
Electric locomotives, number of, 186, 209, 210, 212, 288; cars equipped with, 291; estimates of cost of operation, 411.
Electric motors, cars equipped with, 209, 291.
Electric power. *See* Power.
Electric railways, power statistics, 183; number that neither bought nor sold current, 199; total operating expenses, 317; motor improvements, 411.
Electric railways and central electric stations combined, primary power, dynamo capacity, and output of stations, 183.
Electric suburban lines, new types of, 380.
Elevated and subway companies, miles of track operated, 181, 212, 283; rolling stock, 212; traffic, 216; capitalization, 230; income, 240; revenues, 244; expenses, 250; general results of operation, 257; fare limits, 416.
Elevated track, miles operated, 200.
Employees, number of, 182, 184, 186, 324; by classes of occupation, 269, 270; by classified groups of companies, 272; salaries and wages, 324, 325. *See also* Salaried employees.
Engines, number and horsepower of, 196, 197.
Equipment, expenses of, 246, 311, 315; subsidiary, 280; cars classified according to, 291.
Expenses. *See* Operating expenses.
Express business. *See* Baggage, etc., business.
Express, freight, mail, and baggage cars. *See* Cars.
Express and interurban cars. *See* Cars.

Fare boxes, data regarding, 419.
Fares, rates of, 217, 218, 415.
Floating debt, amount of, for operating and lessor companies combined, 323.
Floating debt and mortgages, amount of, 299.
Florida. *See* States.
Freeport (Ill.) Railway & Light Co., treasurer quoted regarding one-man prepayment cars, 366.
Freight business, companies reporting, 222, 258; income from, 222, 308.
Freight cars, operating revenues from, 308.
Freight revenues, companies reporting, 258.
Fuel, expenses of, for power, 316.
Funded debt, amount of, 186, 191, 264, 299, 318, 323.
Funeral trolley cars. *See* Cars.

Gas and oil engines, number and horsepower of, 183, 196, 197, 279.
Gas-electric cars. *See* Cars.
Gas-electric motors, trackage operated by, 200.
Gasoline cars. *See* Cars.
Gasoline motor power, subways operated by, 182; track mileage, 184, 200, 283; companies using, 195; cars equipped with, 209, 291.
Generators, auxiliary, number and kilowatt capacity of, 196, 280.
Geographic divisions, primary power, 183, 278; dynamo capacity and output of stations, 183; relation of traffic to population, 190; number of operating companies, 202; miles of track operated, 202, 282, 299; per cent distribution, 208; miles of track owned and leased, 206; brake equipment, 210; electric locomotives, 210; passengers, car mileage, and car hours, 213, 292; per cent ratio of transfer and free passengers to revenue passengers, 214; rates of fare within city limits, 218; freight, mail, and express business, 222, 258; income, 223, 245, 302; capitalization, 225, 299; companies with income from sale of current, 239; operating revenues, 241, 308; per cent distribution, 242; deductions from income, 251; taxes, 254; operating ratios, 262; companies reporting surplus balances and deficit balances, 265; debt, 266; balance sheets, 268, 318, 322; employees, salaries, and wages, 270, 324; average number of employees per company, 271; revenue from sale of current and income of electric light and power departments, 276; generating and subsidiary equipment, and current generated and purchased, 280; cars and electric locomotives, 288, 290; operating revenues, 308; operating expenses, 311, 314.
Georgia, per cent increase in assets and liabilities, 267; transmission lines, 349. *See also* States.
Georgia Railway & Power Co. (Atlanta, Ga.), hydroelectric system built by, 337; example of power-transmission service furnished by, 349.

High-voltage installations, list of, in United States and Canada, 406.
Holding companies, classes of, 180; capitalization, 226; income account, 227.
Hydroelectric development, examples of, 337, 343.

Ice-making, steam generator plants of street railway applied to, 337.
Idaho. *See* States.
Illinois, electric track other than overhead trolley, 201; total trackage, 205; express, freight, mail, and baggage cars, 209; income accounts, 227, 305, 306; average gross income, 261; increase in assets and liabilities, 267. *See also* States.
Income, amount of, for electric light and power departments, 275; for operating companies, 186, 302; for lessor companies, 186; for nonoperating or lessor companies, 305; for operating and lessor companies combined, 306.
Indiana, express, freight, mail, and baggage cars, 209; increase in assets and liabilities, 267; income accounts, 305, 306. *See also* States.
Indianapolis power plant, description of, 328.
Injuries and damages, expenses of, 247, 317.
Insurance, use of term, 247; amount of, 317.
Interborough Rapid Transit Co. (N. Y.), description of turbines for use of, 332.
Interest, amount of, 186, 255, 299; analysis of, 228.
International Railway (Buffalo, N. Y.), installation of combination lighting and trolley poles by, 356.
Interurban lines, track mileage of, 200, 283.
Investments, amount of, for operating and lessor companies combined, 191, 318.
Iowa, express, freight, mail, and baggage cars, 209; per cent increase in assets and liabilities, 267. *See also* States.

Kansas, miles of track other than overhead trolley, 201; average gross income, 261; per cent increase in assets and liabilities, 267. *See also* States.
Kansas City, Clay County & St. Joseph Railway, interurban systems of, 350.
Kentucky, income account of holding companies, 227; average gross income, 261. *See also* States.

Lawrence (Kans.) Railway & Light Co., manager quoted regarding one-man prepayment cars, 367.
Leased track, increase in mileage of, 207.
Lessor companies, member of, 180, 182, 184, 186, 306; cost of construction and equipment, 182, 264; income, 186; capitalization, 223; interest, 255; balance sheets, 264, 266; number reporting surplus balances and net balances, 265. *See also* Nonoperating, etc., companies, *and* Operating, etc., companies.
Liabilities. *See* Assets, etc.
Light and power departments, total operating expenses, 317.
Line, miles operated, by operating and lessor companies, 182, 184, 186; by individual companies, 188; features of construction, 349. *See also* Electric lines.
Locomotives. *See* Cars, etc., *and* Electric locomotives.
Long Island, description of cars used, 378.
Louisiana, increase in assets and liabilities, 267. *See also* States.
Louisville Traction Co., description of generating station operated by, 329.

McKinley System (Marseilles, Ill.), power station of, 343.
Mail business, companies reporting, 222, 258; income from, 222, 308.
Maine. *See* States.
Managers and superintendents, number and salaries of, 269, 270, 325.
Manhattan & Queens Traction Corporation, dimensions of cars in use by, 378.
Maryland, miles of track other than overhead trolley, 201; total trackage, 205; express, freight, mail, and baggage cars, 209. *See also* States.
Massachusetts, miles of track other than overhead trolley, 201; total trackage, 205; express, freight, mail, and baggage cars, 209; income accounts, 227, 305, 306; average gross income, 261; increase in assets and liabilities, 267; hydroelectric energy for trolleys, 340. *See also* States.

Merrill Railway & Lighting Co., trackless trolley bus in operation by, 369.
Michigan, miles of track other than overhead trolley, 201; total trackage, 205; express, freight, mail, and baggage cars, 209. *See also* States.
Milk business. *See* Baggage, etc., business.
Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Co., cost of operating gas-electric motor cars by, 374.
Minnesota, miles of track other than overhead trolley, 201; average gross income, 261. *See also* States.
Mississippi, per cent increase in assets and liabilities, 267. *See also* States.
Missouri, total trackage, 205; average gross income, 261; transmission system, 350. *See also* States.
Montana, total trackage, 205. *See also* States.
Mortgages. *See* Floating debt, etc.
Motive power, increase in, 188; character of, 200; track mileage, classified according to, 283.
Motor generator sets. *See* Rotary converters, etc.
Motormen, number and wages of, 269, 270, 325. *See also* Conductors, etc.
Motors, cars equipped with, 209, 288, 291, 411. *See* Electric motors.
Municipal railways, number operated, 179.

Nashville-Gallatin Interurban Railway (Tenn.), completion of direct-current interurban line by, 381.
Nebraska, per cent increase in assets and liabilities, 267. *See also* States.
Nevada. *See* States.
New Hampshire. *See* States.
New Haven System, main switching yards of, 409.
New Jersey, miles of track other than overhead trolley, 201; total trackage, 205; average gross income, 261; income accounts, 305, 306. *See also* States.
New Mexico. *See* States.
New York, miles of track other than overhead trolley, 201; total trackage, 205; express, freight, mail, and baggage cars, 209; income accounts, 227, 305, 306; average gross income, 261; increase in assets and liabilities, 267; purchased power, 347; fare limits, 415. *See also* States.
New York, New Haven & Hartford Railroad, length of electrified track operated by, 401.
New York Central Railroad, larger locomotives required by, 409.
New York City, traffic density of roads, 215.
New York Municipal Railway Corporation, unusual subway car designed by, 367.
New York State Railways, miles of line and track operated by, 188.
Newport News & Old Point Railway and Electric Co., ice-making apparatus of, 337.
Nonoperating or lessor companies, number and income account of, 235, 305.
Nontransportation revenues, amount of, 186.
Norfolk & Western Railway, "split-phase" locomotive equipment, 407.
North Carolina, per cent increase in assets and liabilities, 267. *See also* States.
North Dakota. *See* States.
Northern Illinois Light & Traction Co., general superintendent quoted regarding one-man prepayment cars, 367.

Oakland, Antioch & Eastern Railway (Cal.), interurban electric systems of, 380.
Ohio, miles of track other than overhead trolley, 201; total trackage, 205; express, freight, mail, and baggage cars, 209; average gross income, 261; increase in assets and liabilities, 267; income accounts, 305, 306.
Ohio Electric Railway Co. (Ohio), miles of line and track operated by, 188.
Oil engines. *See* Gas, etc., engines.
Oklahoma, per cent increase in assets and liabilities, 267. *See also* States.
One-man prepayment cars. *See* Cars.
Operating companies, number of, 180, 182, 196, 202, 278, 292; cost of construction and equipment, 182, 264; income, 186, 232–234, 237, 245, 302; comparative size of, 188; distribution of gross income, 191; miles of track owned and leased, 206; capitalization, 223; without and with commerical lighting, 238; deductions from income, 251; interest, 255; income, expenses, and dividends per revenue passenger, 261; balance sheets, 264, 266; number reporting surplus balance and deficit balance, 265; employees, salaries, and wages, 270–272, 324; classified groups, 272; track mileage owned by, 282; rentals from, 306.
Operating and lessor companies combined, cost of construction and equipment, 182, 184, 264, 318, 322; analysis of dividends and interest, 228; capitalization, 229; income, 232, 236, 306; balance sheets, 264, 265, 268, 318, 322; debt, 266; assets and liabilities, 322, 323.
Operating expenses, amount of, 186; factors influencing, 245; classification of, 246; by accounts, 248, 311, 314, 316; per mile of track, 258; per car-mile and per revenue passenger, 260.
Operating ratios, for classified groups of companies and by states, 262; relation to density of traffic, 263.
Operating revenues, amount of, 186, 308; source of, 241, 243; per cent distribution, 242, 243; per mile of track, 258; per car-mile and per revenue passenger, 260.
Oregon, express, freight, mail, and baggage cars, 209; increase in assets and liabilities, 267. *See also* States.
Output of stations, total, kilowatt hours, 183, 186; current generated and purchased, 196, 198, 280.
Overhead trolley, trackage operated by, 200, 201

Pacific Electric Co. (Cal.), miles of line and track operated by, 188.
Pacific Electric Railway of Los Angeles, Cal., catenary construction by, 352.
Parlor, etc., cars. *See* Cars.
Passenger cars. *See* Cars.
Passenger traffic, comparison of street and electric railway with steam railroads, 215; conditions of, 417.
Passengers, total number carried, 186, 213, 292.
—— free, number of, 292.
—— revenue, number of, 182, 184, 292; per mile of track, 184, 186, 214, 293; by classified groups of companies, 272.
—— transfer and free, ratio to revenue, 214.
Paving, methods of, 387.
Pennsylvania, miles of track other than overhead trolley, 201; total trackage, 205; express, freight, mail, and baggage cars, 209; income accounts, 227, 305, 306; average gross income, 261; increase in assets and liabilities, 267. *See also* States.
Pennsylvania Railroad, purchased power for operation of suburban lines, 349.
Philadelphia, traffic density of roads, 215; fares in force, 415.
Philadelphia Rapid Transit Co. (Pa.), miles of line and track operated by, 188; description of funeral car in use by, 370.
Pittsburg Railways Co. (Pa.), miles of line and track operated by, 188.
Pittsburgh, description of double-deck cars used in, 357.
Pittsburgh & Butler Street Railway, substitution of direct current for single-phase alternating system, 382.
Poles, description of, 352, 353.
—— concrete, 354, 355.
—— wooden, 353.
Portland Railway, Light & Power Co., electric equipment of, 338.
Power, character of, 182, 183, 189; comparative summary, 186; kinds of, 195; classified according to income from railway operations, 198; other than electric, 205; operating expenses, 246, 311, 315.
—— animal, railways operated by, 182; miles of track operated by, 184, 200, 283; companies using, 195.
—— cable, railways operated by, 182; miles of track operated by, 184, 200, 283; companies using, 195; cars equipped with, 291.
—— electric, railways operated by, 182; miles of track operated by, 184, 200, 283; companies using, 195.
Power plant equipment, companies with and without, 195.
Prepayment cars. *See* Cars.
Primary power, horsepower of, 183, 278; number of units and horsepower, 196, 197.
Printing. *See* Stationery, etc.
Private right of way, track mileage on, 200, 283.
Public Service Railway Co. (N. J.), miles of line and track operated by, 188.
Public thoroughfares, track mileage on, 200, 283.
Puget Sound Railway, power rate for, 349.

Railroads, classes of, 179.
Railways. *See* Electric railways.
Real estate mortgages, amount of, for operating and lessor companies combined, 323.
Rent of equipment, use of term, 247; amount of, 317.
Rent of leased lines and terminals, amount of, 186, 251, 255, 307.
Rent of tracks and terminals, use of term, 247; amount of, 317.
Reserves, amount of, for operating and lessor companies combined, 323.
Revenues. *See* Operating revenues.
Rhode Island, total trackage in, 205. *See also* States.
Rhode Island Co. (Providence), system of fare-box collection, 419.
Rotary converters and motor generator sets, number and kilowatt capacity, 196, 280.

Salaried employees, number of, 186, 269, 270, 324; by classified groups of companies, 272; salaries, 186, 269, 324.
Salaried officers of corporations, number and salaries of, 269, 270, 324.
Salaries, by classes of occupation, 270, 324; per cent distribution, 269; by classified groups of companies, 272.
Salaries and wages combined, amount of, 186; ratio to operating expenses and operating revenues, 273, 274.
Service cars. *See* Cars.
Sidings and turnouts, track mileage of, 200, 282.
Signaling and dispatching, increased attention paid to, 393.
Single-phase railway, installation of, in United States and Canada, 406.
Sinking and other special funds, amount of, for operating and lessor companies combined, 322.
Snowplows. *See* Service cars.
South Boston power plant, efficient operation of, 327.
South Carolina. *See* States.
South Dakota, miles of track other than overhead trolley, 201; total trackage, 205. *See also* States.

Stable expenses. *See* Store, etc., expenses.

States, number of operating companies, 202; miles of track operated, 202, 204, 259, 282, 299; miles of track owned and leased, 206; per cent ratio of transfer and free passengers to revenue passengers, 214; rates of fare within city limits, 218; capitalization, 230, 299; income, 233, 259, 302; deductions from income, 251; taxes, 254; operating ratios, 262; ratio of salaries and wages combined to operating expenses, 274; revenue from sale of current, and income of electric light and power departments, 276; primary power, 278; generating and subsidiary equipment, and current generated and purchased, 280; cars and electric locomotives, 288, 290; passengers, car mileage, and car hours, 292; operating revenues, 308; operating expenses, 311, 314; balance sheets, 318, 322; employees, salaries, and wages, 324.

Stationery and printing, expenses of, 247, 317.

Steam (including turbines) and gas engines, number and horsepower of, 186.

Steam engines, number and horsepower of, 278.

Steam engines and steam turbines combined, number and horsepower of, 183.

Steam power, miles of track operated by, 184, 200, 283; companies using, 195; units and horsepower, 196, 197, 278.

Steam railroads, electrically operated divisions of, 179; passenger traffic, 215; capitalization, 229; electrification of main lines, 401.

Steam turbines, number and horsepower of, 278.

Stenographers. *See* Clerks, etc.

Stepless double-deck cars. *See* Cars.

Stock, amount of, for operating and lessor companies combined, 322.

Stock and bond discount, amount of, for operating and lessor companies combined, 322.

Storage batteries, trackage operated by, 200, 201.

Storage-battery cars. *See* Cars.

Store and stable expenses, amount of, 247, 317.

Street and electric railways, comparative summary, 184; relation of traffic to population, 190; power-plant equipment and output of stations, 196; track mileage, 200; operating companies and miles of track operated, 202, 204; track owned and leased, 206; passenger traffic, 215; rates of fare within city limits, 218; capitalization, 223, 229; condensed income account, 234; per cent distribution of operating revenues, 242; operating expenses, 248; deductions from income, 251; taxes, 254; miles of track and income from operations, 259; net balance sheets, 264, 266; employees, salaries, and wages, 269; technical advances in industry, 327.

Street cars, advances and changes in, 356; new types of, 360; illumination of, 391.

Structures. *See* Buildings, etc., *and* Way, etc.

Substation employees, expenses of, 315.

Suburban lines. *See* City, etc., lines *and* Electric suburban lines.

Subway lines. *See* Elevated, etc., lines.

Subway and tunnels, miles of track operated, 283.

Superintendents. *See* Managers, etc.

Surface companies, miles of track operated by, 181, 212, 283; rolling stock, 212; traffic, 216; capitalization, 230; condensed income account, 240; operating revenues, 244; operating expenses, 250; general results of operations, 257.

Surface track, miles operated, 200.

Surplus, amount of, for operating companies, 186, 302; for lessor companies, 186; for nonoperating or lessor companies, 305; for operating and lessor companies combined, 307, 318, 323.

Surplus and deficit balances, analysis of, 267.

Sweepers. *See* Service cars, etc.

T-rail construction, prevalence of, 385.

Taxes, amount of, 186, 250, 251, 254.

Telephones, use of, in train or car dispatching, 397.

Tennessee. *See* States.

Terminals. *See* Tracks, etc.

Terre Haute, Indianapolis & Eastern Traction Co., description of power plant operated by, 328.

Texas, income account, 227, 261; per cent increase in assets and liabilities, 267. *See also* States.

Third rail, trackage operated by, 200, 201.

Track, miles operated, 182, 184, 186, 200, 202, 204, 292; by character of power, 189; by individual companies, 188; miles outside United States, 203; elevated and subway, and tunnel, 205; ownership of, 206; per cent distribution of miles of, 208; by classified groups of companies, 272; owned or operated in division or state, 299; problem of maintenance of, 384; details of type in various cities, 388.

Track mileage, classified by character of motive power, ownership, and location, 200, 282.

Trackage rights, miles of track operated under, 200, 282.

Trackless trolley bus, operation of, 369.

Tracks and terminals, rent of, 317.

Traffic, comparative summary, 186; relation to population, 190; passengers, car mileage, and car hours, 213, 292; maximum density, 215; expenses of, 246, 311, 315.

Trainmen. *See* Conductors, etc.

Transfer passengers. *See* Passengers.

Transformers, number and kilowatt capacity of, 196, 280.

Transportation, revenues from, 186; expenses of superintendence, 246, 311, 315.

Treasury securities, amount of, for operating and lessor companies combined, 322.

Trolley brackets, use of, on buildings, 355.

Tungsten-filament lamps, characteristics of 392.

Tunnels. *See* Subway, etc.

Turbines, number and horsepower of, 196, 197. *See also* Steam turbines *and* Water wheels, etc.

Twin City Rapid Transit Co. (Minneapolis), evolution of steam power plant of, 334.

United Railroads of San Francisco, type of new cars for, 368.

Utah, total trackage, 205. *See also* States.

Vermont. *See* States.

Virginia, total trackage, 205; average gross income, 261; per cent increase in assets and liabilities, 267. *See also* States.

Waco (Tex.) Street Railway, manager quoted regarding one-man prepayment cars, 365.

Wage earners, number and wages of, 186, 269, 270, 325; by classified groups of companies, 272.

Wages, amount of, by classes of occupations, 270; per cent distribution, 269; by classified groups of companies, 272, 324.

Washington, miles of track other than overhead trolley, 201; total trackage, 205; express, freight, mail, and baggage cars, 209; increase in assets and liabilities, 267. *See also* States.

Washington (D. C.) Railway & Electric Co., opinion of company regarding fare boxes, 420.

Water wheels, number and horsepower of, 183.

Water wheels and turbines, number and horsepower of, 186, 196, 197, 279.

Way and structures, operating expenses of, 246, 311, 314.

West Virginia, per cent increase in assets and liabilities, 267. *See also* States.

Wisconsin, average gross income, 261; per cent increase in assets and liabilities, 267. *See also* States.

Wooden poles. *See* Poles.

Worcester (Mass.) Consolidated Street Railway System, hydroelectric energy for operation of railways, 340.

Work cars. *See* Service cars.

Wyoming. *See* States.

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